POULTRY HUSBANDRY

WORKS BY MR. EDWARD BROWN, F.L.S.

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POULTRY HUSBANDRY

BY

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SWEDEN, BELGIUM, GERMANY, AND HOLLAND, ETC.

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PREFACE

In 1891 the first edition of "Poultry-Keeping as an Industry for Farmers and Cottagers" was issued. The time was propitious in that we were on the eve of great developments, equally as to advance in consumption of eggs and poultry and efforts for increase of production at home and abroad. Until that time, with the exception of a few lectures which I had given at what is now the Munster Institute, Cork, there was no Agricultural College or educational authority in the United Kingdom which devoted any attention to Poultry as a practical subject. In the year named a large sum of money was granted by Parliament to County Councils, upon whom was placed the responsibility for technical instruction. This led to my devoting several years to direct teaching in association with County Councils, and to much of my later work.

When the grant was made, our imports of eggs and poultry were in value less than £4,000,000 per annum; in 1913 they amounted to £10,500,000. In 1891 Irish production did not exceed £2,000,000; in 1913 it was £5,000,000. In the former year British production was certainly not in value more than £5,000,000; now it exceeds £9,000,000. Thus, in the interval production in the United Kindgom has increased by 100 per cent., imports by 162½ per cent., and consumption by 122 per cent.

That, however, is the least part of the change which has taken place. The whole aspect of affairs has been altered. Instead of prejudice and bitter antagonism, in the main there is sympathy and recognition. The most difficult task at the time named was to combat the spirit of disbelief in Poultry Husbandry as a profitable branch of live stock breeding. To a large extent even that has been overcome. Our greatest immediate danger is due to those whose imagination is vastly in excess of their experience. As to the extent of operations and methods adopted, what has been accomplished in a little more than two decades forms one of the most remarkable chapters in the records of progress. That is true in other countries equally with our own.

The time has come, therefore, to deal with the subject on broader lines. The former work has served its purpose. To merely revise it was not enough. When that was written I had studied the methods adopted in France, Belgium, and Denmark as well as at home. Since then I have visited nearly every European country, and also Canada and the United States, in pursuit of knowledge, meeting the men who, as educators or practicians or scientists, are contributing their share to a wider knowledge and an enlarged experience in what is now one of the most important of our rural industries. It has been my desire to embody the result of these observations in the following pages. That the future will assuredly see even greater changes than have yet been made cannot be questioned. All now attempted is to record the present position, so far as it is known, and to suggest the lines of future development. This I have endeavoured to do.

EDWARD BROWN.

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CHAPTER I

THE POULTRY INDUSTRY

THE growth of egg and poultry production on business lines in nearly all countries over the entire globe within the last two decades has been remarkable. Only those who have had an opportunity by continuous observation can form any idea of what has been done in this way. Few there are, however, who fully realize the progress made, for much of that is unrevealed. Frequently small in the individual case, it is enormous in the aggregate. The evidences are everywhere apparent that a considerable advance in poultry-keeping on what may be termed business lines—by which is meant that food production is the main object, as distinct from amateurism, breeding for pleasure or exhibition, and maintenance on farms merely to provide for household requirements or to supply the good wife with pin-money, which was at one time all too general, and is still met with to a large extent—has been made. In some countries progression is less marked, for there the industrial aspect was already regarded to a considerable extent; in others it has been more pronounced, due to the fact that in these the opportunities for development were much greater. Whilst, therefore, there is no country of which I have knowledge where the poultry industry is incapable of great development, and few in which the limit of production is in sight, the majority have merely made a beginning. In the latter vast opportunities present themselves. Beyond all are the unoccupied areas of older and newer countries waiting to be utilized. The human factor is of supreme importance. Poultry require, and must have, land on which to grow and live, from which to obtain their food. All the land, however, is useless unless it is occupied by a settled population. What the total production will be when the vast areas awaiting occupation are peopled no one can estimate. What has been accomplished is small as compared with what may yet be done. It is all-important, therefore, that each step forward shall be, as far as possible, on lines which make equally for permanency and economic success.

Poultry-Keeping.—The old term given here fitly expresses what has been the case in the past, with, of course, exceptions such as are noted in the following pages—namely, that the owners "kept" the fowls, literally as well as morally. It is not too much to state that under the older methods, when the poultry were regarded as a non-economic section of the live-stock, and little attempt was made to deal with them as with other classes of farm animals in which productiveness as related to cost was kept prominently in view, or when those who adopted more progressive ideas were mainly amateurs, and whose operations could be no more profitable than is an ornamental garden or conservatory, the vast majority of poultry kept were unprofitable in the usual interpretation of the term. The old saying that "poultry don't pay" was true when applied to such conditions. There were, however, abundance of cases of individuals and of districts in different countries by which the falsity of this axiom, except for the indolent and the ignorant, could be proved, and where it was evident that, given good conditions and right methods, more especially in association with cultivation of one form or another, poultry could be made profitable to an extent equal with, if not to a greater extent than, any other branch of domestic livestock. To realize that fact, it was necessary for a complete change of methods and ideals to be adopted. Such has been to some extent realized. What we have now to aim for is to bring about that alteration of system which will make poultry husbandry commercial in the fullest sense, so that in the future we may more and more look to the fowls to help keep their owners, rather than the owners keep them. One of the objects of the present work is to show what has been and how it is being done, and, as far as may be, to point out the line of future development in the light of such experience as is available.

Recent Growth.—To those who have contributed their quota to the development of poultry breeding and production as an economic pursuit, the marked advance which has followed such efforts is satisfactory in the extreme, even though the consciousness of what may yet be accomplished is paramount. It is not too much to claim that in no branch of rural industry has the same advance been made as in that which we are considering.

To deal with the different countries in detail would require a very large amount of space, and to attempt it is beyond the scope of the present work. I am compelled, therefore, to briefly generalize in this direction, and to limit special treatment to the British Isles. Suffice it to say that in the majority of European countries, as well as the United Kingdom—more especially Belgium, Holland, Germany, Italy, Austria-Hungary, and Russia — great advance has been or is being made, the most notable of which is found in Denmark, Ireland, and Russia; that in Canada and the United States the progress to be noted is phenomenal, possibly greater than over the rest of the world; and that in Australia and New Zealand considerable growth is recorded. When we find a small country like Denmark creating within twenty years an export egg trade now reaching more than £2,000,000 in annual value; Ireland advancing her exports of eggs and poultry to Great Britain within the same period from about £1,600,000 to nearly £4,000,000 annually, and that these two products are equal in value to the dairy exports for which that island has always been famous; the United States estimating her production at nearly $800,000,000 (£160,000,000) per annum, with other nations making advances to a greater or lesser extent; and Ministries of Agriculture in nearly every country seeking to increase and extend poultry-breeding and trade in eggs and fowls, it is at once evident that we are dealing with a pursuit of considerable importance. The once-despised hen is at last receiving the recognition so long denied her, and assuming her place in solution of the great food problem, which, perhaps, is the most serious question presenting itself at this time, both as to prices and volume. Rapid increase in the number of the world's inhabitants, combined with aggregation in dense communities as a result of commercial and industrial developments, make a huge demand upon food resources, and is profoundly altering the whole position of affairs. Nor does there appear any immediate probability of check to this tendency. The consuming population of the earth has grown more rapidly than the producing, which fact explains to some extent the rapid advance in prices. What has now to be done is to stimulate to the utmost production on lands which have been long settled, making these yield higher returns, and as far as possible bring into use the uncultivated areas of every country. Whilst, therefore, more poultry is essential, equally there must be efforts to secure better poultry—that is, to obtain a higher average of yield from what we already possess. Such can only be accomplished by wide dissemination of knowledge and experience.

Great Britain.—Until the poultry census was taken in 1908, there were no reliable returns as to the poultry population of England, Scotland, and Wales. Ireland and most other countries were able to show statistics affording a basis for comparisons. During the years 1884 and 1885 poultry were included in the annual British livestock returns, but these were manifestly incomplete, and did not discriminate between adult and young stock. If these are taken, however, the results afford ground for satisfaction, in that from 1885 to 1908 fowls had increased by 623 (381 to 1,004) per 1,000 acres of cultivated land; ducks increased by 23 (68 to 91); geese had decreased by 5 (27 to 22); and turkeys had increased by 6 (15 to 21), proportionate to the area named. Taking all together, the net increase was in twenty-three years, if these returns are comparable, 231 per cent. That is quite within a reasonable computation, though far below what is the case in some countries.

A correct computation, however, cannot be based upon the grouping together of old and young birds. What must be taken is the number of adult fowls, as these form the productive stock of the country. I have, therefore, extracted from the 1908 census returns the number of birds hatched prior to that year, and worked out the number per 1,000 acres of cultivated land for the respective countries. As, however, fowls and ducks are so much smaller in body, and require much less space than do geese and turkeys, in the second column under each head of the following table the last-named have been corrected in averages —that is, multiplied by five, on the assumption that the number stated of fowls or ducks is equal to one goose or turkey. This enables us to obtain an indication of what was the position in the year named in relation to the capacity of the country.

Average Number of Adult Poultry in Britain (1908) per Thousand Acres of Cultivated Land.

Country.	Fowls per 1,000 Acres.	Ducks per 1,000 Acres.	Geese.		Turkeys.		All Poultry.	
			Actual per 1,000 Acres.	Corrected Averages.	Actual per 1,000 Acres.	Corrected Averages.	Actual per 1,000 Acres.	Corrected Averages.
England ..	560·0	30·0	7·0	35·0	5·9	29·5	602·9	654·5
Wales ..	444·8	36·9	24·7	123·5	8·9	44·5	515·3	649·7
Scotland ..	499·4	38·0	2·4	12·0	5·5	27·5	545·3	576·9
Great Britain	538·4	31·9	7·8	39·0	6·1	40·5	584·2	639·8

These figures show that upon the farms of the country there was less than two-thirds of a fowl, or its equivalent, per acre of cultivated land in Great Britain, England and Wales being fairly equal, and Scotland, except in a few districts, considerably behind. Such cannot be regarded as a satisfactory condition of affairs, and, as shown later, is far below the capacity of the country. Though the progress made from 1885 to 1908 was considerable, there is abundance of room for development. In addition to the adult poultry, the number of young birds recorded on June 4, 1908, was as follows:

Chickens	14,913,000
Ducklings	1,934,000
Goslings	459,000
Turkeys	498,000

The total number of adult and young poultry respectively was almost the same, the older birds being slightly in excess. It is necessary to remember that the figures quoted only apply to occupations of an acre and upwards. Therefore, all allotments of less than an acre, cottage gardens, and fowls kept by other rural and by urban and suburban residents, are excluded. It is not too much to say that in many districts the numbers recorded would have been more than doubled had these been included. As examples may be cited Lancashire and Yorkshire, where it is certain that the total of fowls kept on plots of less than an acre are vastly in excess of those found on the farms of these great counties. We have, however, to accept the statistics provided.

Ireland.—The section of the United Kingdom which has made the greatest advance in connection with poultry husbandry is Ireland, which, as figures given below indicate, is considerably in advance of Great Britain. It was my privilege in 1887 to take part in laying the foundations for such development. In the year named I was commissioned by the proprietor of the *Weekly Freeman* of Dublin, the late Mr. E. Dwyer Gray, M.P., to make an exhaustive inquiry into the poultry industry of that country, with a view to seeing how far it was capable of extension, and the lines upon which it could be developed. The results have indeed been remarkable, not only in respect to an increase of exports, but also to advancement of the prosperity of its people. At that time the way in which eggs and poultry were packed and shipped was about as bad as it well could be, with few exceptions. Coming a little later into competition with produce from France and Denmark, carefully graded and packed and in fine condition, for a time Irish supplies were at a discount, commanding very low prices. Thanks to the efforts put forth, there has been a revolution in these directions, and Irish produce now holds a relatively high place on the British markets, though there is much yet to be done by adoption of improved methods. Poultry and egg production now occupies the third place in Ireland's rural industries, and has contributed very largely to its prosperity.

In 1887, when the inquiry already referred to was made, there were no official figures as to the value of exports. Statistics were, however, obtained from all ports of shipment, from which it was estimated that the total value of eggs and poultry shipped to Britain was £1,666,000. Since 1904 official returns have been available, showing a steady rise. In 1912 the exports were—

	£
Eggs	2,926,582
Poultry	1,037,771
	3,964,353

If feathers are added, the total would be upwards of £4,000,000. The dairy industry, for which Ireland has always been famous, exported butter to the value of £4,159,972, and cheese £32,832, or a total of £4,192,804. One striking fact is that the imports of poultry into Britain in the year named from all colonies and foreign countries was, less re-exports, £725,146, so that Irish supplies were greater by no less a sum than £312,625, which is a remarkable tribute to the efforts of central and other authorities engaged in developing the resources of the country.

Taking the same basis as adopted for Great Britain, the following are the averages of poultry for Ireland:

Average Number of Adult Poultry in Ireland (1913) per Thousand Acres of Cultivated Land.

Fowls per 1,000 Acres.	Ducks per 1,000 Acres.	Geese.		Turkeys.		All Poultry.	
		Actual per 1,000 Acres.	Corrected Averages.	Actual per 1,000 Acres.	Corrected Averages.	Actual per 1,000 Acres.	Corrected Averages.
796·8	140·0	31·0	155·0	11·6	58·0	179·4	1149·8

It will be seen, therefore, that the actual number of poultry in Ireland (1913) was greater by 67 per cent. than in Britain (1908), and that the corrected averages was greater by 79 per cent.

Production in the United Kingdom.—The figures here set forth enable us to form an estimate as to the total value of the eggs and poultry produced in the United Kingdom. Taking the tables as given in the poultry census of 1908 for Great Britain, and adding to these the smaller poultry-keepers who conduct their operations for home consumption or sale, a conservative assumption is that producers realize in one way or the other a return of £10,000,000 per annum. In Ireland we have to add to the export figures the home consumption, which may be safely placed at £1,000,000 annually. Therefore, we arrive at the conclusion that the total wholesale value of eggs and poultry produced in the United Kingdom is at least £15,000,000 per annum. To these, however, should be added all the contributory business done, such as sale of appliances, foodstuffs, stock, and traders' profits, so that the total value of the poultry industry must be nearly £20,000,000 annually.

We have also to take into account the imports, which in 1913 were as follows:

	£
Eggs	9,590,080
Poultry	955,238
	10,545,318

Thus the total consumption of these two articles of food is £25,545,318.

Such figures are large in the aggregate, but small individually when divided. The annual consumption of eggs is only about 111 per head of the population, and less than one fowl per head per annum, which is an indication that the consuming capacity of the country is far from being reached. In several countries the consumption of both eggs and poultry is higher than in the United Kingdom. As it is, the total weight of the eggs consumed reaches the enormous figure of 347,000 tons yearly, on the usual trade basis of 120 great hundreds to the ton, of which nearly 200,000 tons are produced within the British Isles.

Capacity for Production.—In this connection it is desirable to seek for guidance as to what are the possible developments of the country, with a view to discernment as to how far increase can be obtained. Thirty-five years ago, when I first studied this question in its economic aspect, the fact which burnt itself upon my mind was that, of the hundreds of thousands of farmers and others in this country, merely a fraction were attempting to deal with egg and poultry production on business lines, as that the latent possibilities of demand for these articles of food were almost incalculable. At a later period it seemed as if much might be done by establishment of special poultry farms. Experience both at home and abroad speedily dissipated that idea. It was seen that a country can only be fed, so far as natural products are concerned, by agriculturists, and that fowls cannot be treated in factory fashion, except in the final processes such as fattening. These must be grown and maintained in due relation to cultivation, as are other classes of stock. After many years of careful study and observation, the conclusion arrived at was that, taking the country as a whole, three adult fowls, or their equivalent, on the assumption that five fowls or ducks are equal to one goose or turkey, could be maintained continuously per acre of cultivated land, without displacement of any other stock or interference with any crop. Upon this basis, which, it may be explained, has nearly been reached in one Irish county, it is possible to form a reasonable estimate of how far the nation as a whole could provide for its own needs. The following calculations do not take into account rough grazings, of which there are nearly 13,000,000 acres in Britain alone, but include occupations below an acre in extent:

Country.	Acres of Cultivated Land.	Present Number of Adult Fowls (corrected).	Possible Number of Adult Fowls (3 per Acre).
England	24,414,493	15,469,000	73,243,479
Wales	2,760,197	1,628,000	8,280,591
Scotland	4,821,334	2,731,000	14,464,002
Ireland	14,673,788	15,640,000	44,021,364
Totals	46,669,812	35,468,000	140,009,436

A modest estimate is that, on the basis stated of three adult fowls to the acre, there should be a gross annual return in sales of eggs and poultry, or those consumed in the households of owners, equal to £1 per acre per annum. That amount is often exceeded as a result of good management, and I have known as much as 30s. to 40s. per acre realized in this way, which, as supplemental to ordinary cropping, is an important addition. It is safer, however, to take the lower sum. Whether eggs, or chickens, or ducklings, or goslings, or turkeys are produced does not affect the calculation. A further point is the manurial value of fowls, which may be reasonably computed at 3s. 4d. per acre per annum, inclusive of the young stock reared. The results would therefore be—

Country.	Possible Annual Value at £1 per Acre.	Manurial Value at 3s. 4d. per Acre.
England	£24,414,493	£4,069,082
Wales	2,760,197	460,033
Scotland	4,821,334	803,556
Ireland	14,673,788	2,445,631
Totals	£46,669,812	£7,778,302

The full county figures take too much space to quote, but can be worked out from the agricultural returns. That our people could consume all that can be produced is unquestionable. If every inhabitant ate an egg every alternate day, the annual value for this product alone would be £34,000,000 sterling. There is no apparent reason why such should not be attained; and, in addition, poultry could be consumed to a much larger extent.

Consumption of Eggs and Poultry.—Reference has already been made to the respective values of eggs and poultry produced in, and imported into, the United Kingdom, which enables an estimate to be made as to the total consumption. The following figures, in the light of what is recorded above, may be regarded as a conservative representation of the wholesale value of these two products:

	Eggs.	Poultry.	Totals.
British produce	£7,500,000	£2,500,000	£10,000,000
Irish produce	3,750,000	1,250,000	5,000,000
Colonial and foreign produce	9,590,080	955,238	10,545,318
Totals	£20,840,080	£4,705,238	£24,545,318

Great though the consumption which is represented by these figures may be in the aggregate, yet it only represents 11s. per head of the population, or £2 15s. per family per annum, which is a low average, one capable of great increase.

That the very large advance in consumption, of eggs especially, within recent years is due in large measure to changed conditions of life in this and other countries is unquestionable. It is not a mere fashion, but an absolute necessity for food of a highly nutritious nature, yet easy of assimilation. Therefore, we are justified in assuming that consumption will increase at an ever accelerated pace, provided that supplies are forthcoming and prices do not advance sufficiently to check demand. In another place I have suggested "that changes in environment and habits of life lead, apart from other impelling circumstances, to corresponding alterations in the class of food consumed. This is abundantly evident with man and animal alike in all climates. So long as the people live mainly upon the land, working in the open air, and exercising their muscles and organs by hard manual labour, they are able to enjoy and assimilate the coarser, heavier foods; but when their days are to be passed in great cities, expending their energies in factory, or office, or working with brain rather than muscle, nature craves and demands food of a very different class—food that is high in nutritive values, but with a small amount of fibre, easily digested, and appetizing. We have here, apart from other reasons, one explanation of the enormous increase in the consumption of what might be termed lighter articles of food, such as eggs and poultry. It is unnecessary for me to do more than mention this fact, save to emphasize that its recognition leads to the conclusion that the change is permanent, and not transitory. Such being the case, any tendencies to be noted may be regarded as likely to increase rather than decrease."* What is here stated explains the great growth of consumption in all countries, more especially those where industrial and commercial developments are taking place. A further factor, however, is that there has been decided advance in the qualities of supplies, due to adoption of improved and more expeditious methods of marketing, and the stimulation of production by realization of higher prices.

Advancing Prices.—One of the marked tendencies of recent years has been a steady advance in the prices of nearly all classes of food products, in some more than others. The effect is to enhance the cost of production, though that does not offer an entire explanation. The law of supply and demand largely determines values. So far as eggs and poultry are concerned, it is undoubtedly true that demand has increased much more rapidly than supply, great though the advance of poultry-keeping has been over the entire globe. Several countries which were at one time sending large quantities of eggs and poultry have reduced their supplies considerably, in one or two instances by finding more profitable markets elsewhere, but chiefly owing to greater consumption at home. Special examples are afforded by the British colonies. A few years ago it appeared as if these were to become important sources of our overseas supplies, and for a time the volume of imports from these steadily advanced. Then came a check, and afterwards a steady decline, until now they are a mere bagatelle—only $\frac{1}{4}$ per cent. of our imports, and less than $\frac{1}{10}$ per cent. of our total consumption. Out of every £1,000 worth of eggs and poultry consumed in the United Kingdom, the supplies from British possessions are less in value than £1 sterling.

Within the last ten years the prices of eggs and poultry have steadily advanced. It is difficult to obtain absolute figures respecting the last-named—first, by reason of the fact that

* "Report on the Poultry Industry in Germany," 1912, p. 17.

market reports are not very reliable, in that birds are usually sold by the piece, varying in accordance with size and quality; and, second, that weights of poultry were not recorded in the Trade and Navigation Returns until 1912. We have, therefore, to rely upon the evidence of traders, which is to the effect that there has been a marked increase. So far as eggs are concerned, we are on surer ground. Since 1904, the advance in price of home-grown eggs has been about 2s. per 120. In the same period —1904 to 1912—the average values of Irish eggs have increased from 7s. 1½d. to 9s. 1¾d. per 120. With regard to imported eggs, from 1898 to 1904 they were fairly steady, ranging from 6s. 2d. to 7s. per 120. Since the last-named year, when they were 6s. 9d. per great hundred, the rise was constant and rapid, reaching in 1913 a maximum of 8s. 10¼d. per 120. Up to that time there had been an equally steady decline in quantities, mainly owing to a greater consumption in Germany, which tapped our sources of supply. That country is now the greatest importer of eggs and poultry, the total value of which is upwards of £12,500,000 per annum, having nearly doubled within fifteen years. The returns of imports of eggs into the United Kingdom from 1904 to 1912 were—

	Quantities: Great Hundreds.	Values.
1904	19,942,594	£6,730,574
1912	19,085,052	8,394,524
Variations ..	857,542 (decrease).	£1,663,950 (increase).

Thus, for nearly 103,000,000 fewer eggs, or a reduction of 7,000 tons, imported in 1912 than in 1904, we had to pay £1,663,950 more. In 1913 there was a considerable recovery in quantity, mainly from Russia and Denmark, the total increase, as compared with 1912, being 2,494,898 great hundreds, the total values an advance of £1,196,078. The average price was 8s. 10¼d. The comparisons of 1904 and 1913 were—

	Quantities: Great Hundreds.	Values.
1904	19,942,594	£6,730,574
1913	21,579,950	9,590,602
Increases ..	1,637,356	£2,860,028

Of the eggs imported during recent years, Russia has been responsible for more than 50 per cent., and of poultry she has sent us more than 40 per cent. These are among the cheapest grades seen upon our markets. In eggs, Denmark sends us nearly 20 per cent. of the total. These countries and the Netherlands are the only ones that have made any appreciable increases. Italy and Austria-Hungary have largely decreased.

Effect of High Prices.—So far as I am able to discern, there is no immediate danger of check to consumption of poultry of various grades as a result of enhanced prices. The relative consumption is so small as compared with the population, and the number of householders able to buy even higher grades than at present do so, so far limited, that we can equably face a large increase of better quality birds without fear. It is necessary to remember that the great mass of our people never buy poultry except, perhaps, at the Christmas season. The trade is therefore mainly restricted to those in comfortable circumstances. Such is not the case with eggs, which are entering to a greater extent than ever into the food of our industrial workers. In the Rhine Provinces of Germany I was informed that the wives of working men find that their husbands are as satisfied with two eggs as if they had $\frac{1}{2}$ pound of meat at a meal. The fact is that an egg contains more nutriment than $\frac{1}{2}$ pound of beef or pork. Considering that a couple of eggs cost less than half as much as $\frac{1}{4}$ kilogramme of meat, in view of the great advance in price of the latter, German women use eggs to a much greater extent.

CHAPTER II

THE LINES OF DEVELOPMENT

It is a great gain to have arrived at the stage when general acknowledgment is made that there is need for advance in the poultry husbandry of this country, and also recognition of the fact that opportunities are present enabling such advance to be made. In these respects a great change has come over the scene, which is realizable alone by those who undertook the onerous task of awakening the minds of farmers and others to what was being lost by them. The atmosphere is totally different from what was the case twenty years ago. Instead of indifference on the part of farmers and others most concerned, and the antagonism of those whose interests and sympathies were in other directions, we have hearty co-operation from nearly all classes of the community, and an earnest desire on the part of many farmers to improve this branch of their operations. The responsibility is not so much in the direction of providing a stimulus as of holding those back who, from excess of imagination, plus want of experience, are desirous of taking up this pursuit, knowing little or nothing of what is involved, utterly failing to realize that poultry-keeping must either be part of general farming, or a highly specialized business demanding special qualities and wide knowledge, and should not be undertaken by any who desire to live by it without a thorough training of the most practical character, together either with other means of livelihood or sufficient capital for establishment and carrying over the initiatory period. It is above all essential to abandon amateur or fancy ideals, which by their limitations have wrought much harm. "Playing at shops" is no qualification for running a business, as many would-be poultry farmers seem to imagine. What has painfully impressed me during interviews with hundreds of inquirers who have sought information upon this subject, is the utter absence of any clear understanding of the position. Misled by extravagant statements of vendors of stock or appliances, or by articles and statements in newspapers, written without any knowledge of what is involved, many have risked and lost their all.

Extensive or Intensive.—It may be well at this point to state that there are two schools of thought in respect to this branch of natural science—for science it is—namely, those who believe that the future of poultry husbandry is to be purely on extensive lines on the one hand, and those who pin all their faith upon intensive methods on the other. It will be seen below that both these systems will have their place, and that neither can solve the problem alone. They, however, differ only in degree. The basal principles must be the same, and one can be the counterpart of the other. At the same time, it must be freely acknowledged that for food production the extensive method—that is, poultry husbandry as part of general farming—is, and will always be, the main source of supply. And, further, as a question of profit, owing to lower cost of production, that offers the greater opportunity, and is of more value in respect to the national welfare. Special breeding establishments are contributory thereto, and intensive methods merely supplemental. What we should aim for, as previously mentioned, is development of farm poultry rather than poultry farming, even though it is admitted other plans may to some etxent be adopted. The great American plants, of which so much has been written, and some of which I have visited, are striking examples of what is here set forth.

In the light, therefore, of what has already been stated, and experience gained as to demand and opportunities, we may consider what can be done. The growth of past days, great though it may have been, is only a beginning. It may be and is necessary to revise our methods, to adopt new ideas, to abandon notions long held. What we must do is to build upon what has been proved, and to recognize natural laws as far as we understand them, which, however valuable these may be if utilized, are bad enemies to fight, and are certain to come off conquerors. Whether our operations be extensive or intensive—and, in my judgment, the former must be depended upon as the permanent factor in poultry husbandry—it is above all essential that there shall be a clear understanding of basal principles in each direction. It cannot too clearly be emphasized that, whilst certain of these principles apply to every form of poultry-breeding, there are others which are peculiar to each. What can be done under one set of conditions is useless under another. Much loss has arisen by thinking that large farm methods may be successfully adopted on small occupations, and *vice versa*.

Farmers and Poultry Husbandry.—A very interesting point arises in this connection—that is, the relative number of poultry kept in relation to the size of the respective farms. Greater space does not mean increased production. In fact, it is generally admitted that in all branches of cultivation and livestock the relative productiveness decreases as the area of land individually occupied increases. Such is certainly the case with poultry in all countries. It is where the occupations are modest in size that we find the greatest number of birds *pro rata*. Here the human factor counts. Men are as essential to development of this industry as are land and fowls. A thousand acres of land divided into twenty or fifty holdings will employ ten to twenty times as many people as the same extent of land embraced within a single ring fence. Hence the importance of recent movements for an increase of small holdings and allotments, not alone as a means of providing livelihood to a greater number of people—though that is a question which demands constant attention—but in respect to a fuller development of the national resources in the direction of food-supply.

Some most suggestive information is given in the poultry census of 1908, in which is recorded the average number of poultry kept per 100 acres in Great Britain with respect to the size of holding. The figures are given below, with the corrected totals in the last column, on the basis of five geese or turkeys being equal to one fowl or duck. It may be explained that these figures are inclusive of adult and young stock.

Average Number of Poultry per Hundred Acres of Cultivated Land.

Class of Holding.	Fowls.	Ducks.	Geese.	Turkeys.	Corrected Totals.
Above 1 and not exceeding 5 acres	940	86	8	7	1,101
,, 5 ,, ,, 50 ,,	244	21	4	3	310
,, 50 ,, ,, 300 ,,	77	7	2	2	104
,, 300 acres	37	3	1	1	50
Total Averages	100	9	2	2	129

Thus it will be seen that there were twenty-two times as many poultry on occupations of less than 5 acres than on farms of 300 acres and upwards, and nearly six times as many on farms of 5 to 50 acres as on those exceeding the last-named area. What is most suggestive is the reduction of the number of turkeys as the size of farm increases, in spite of the fact that this species demands greater range than other poultry. In this direction larger farms are failing to meet the country's requirements, and there is no natural reason why the number of turkeys should not be multiplied tenfold thereon in the near future. It is again the human factor that is at fault.

Relationship to Cultivation.—In considering this branch of the subject—namely, farm poultry-keeping—it cannot be too strongly emphasized that fowls must bear in number and distribution relationship to cultivation. That in this direction there may be variations can be accepted. In some places—that is, upon some soils—more can be kept than upon others. The basis is, however, the same. This question is further considered below under the head of Manurial Influence. What I desire to make clear is that an excess of animal life is certain to induce disease, as a result of tainted ground. That applies to poultry as much as to other stock. Therefore plant growth must be the greater. Practically speaking, many of the failures met with, and all the epidemics which I have seen, have been due to a lack of recognition of what is here set forth. To avoid this, the birds must be distributed over the area available. It is not enough to maintain fowls on the basis already laid down in the previous chapter—namely, three adults to the acre—if all are concentrated around the homestead. In that case the last state would be worse than the first. A striking example of what is here submitted has been seen in connection with turkey-breeding in Connecticut and Rhode Island, in the United States, where a once-important industry has been almost destroyed. Although the farms are fair in size, the birds were, as a rule, kept near the homesteads continuously year by year on the same ground, with the result that the land became turkey sick, a disease known as "blackhead" broke out, and there was widespread disaster. On farms, therefore, the primary need is for making poultry part of the operations, and to keep only as many as can become a rotation without injury to the ordinary cropping, whatever that may be.

Arable versus Pasture Land.—Hitherto the great majority of those who have taken up poultry-keeping, whether as stock breeders or for market requirements, have regarded grassland as most desirable for their purpose, mainly by reason of the fact that pastures supply a large amount of green food, and also that the need for experience as to cropping and cultivation of the soil is obviated. Exceptions are, however, to be found. Where fruit is the first object, and poultry supplemental thereto, the advantages of broken ground have been abundantly evident. Up to the present period those who have adopted the method of poultry-keeping on arable or dug land have been chiefly fruit-growers, cottagers, and small occupiers with a very limited area of ground available. Some very striking cases have been published of success achieved by the combination named. We all know that when fowls are " yarded," to use an Americanism, the grass becomes coarse and grows in clumps, which are unsightly, and the herbage fails to completely utilize the manure. Such may be regarded as a sign that the time has come when removal is essential.

My observations in Belgium, Denmark, and elsewhere, as well as in our own country, have shown that much larger flocks of poultry can be kept by arable farmers than has hitherto been thought possible. The opportunities for extension under such conditions are very great. To carry out the work successfully, however, methods must be adopted in accordance therewith.

The Colony System.—Under certain conditions, one of which is referred to in the next paragraph, it is often felt undesirable to scatter fowls all over a farm. That may be a question of labour or of convenience. What is meant by the colony system is that a portion of the land is thickly occupied by fowls for twelve months, when they are transferred to another portion of the farm, and that vacated is cultivated or cropped in the usual manner, decided by whether it is arable or pasture. I first saw this system operated upon a large scale in the Little Compton district of the State of Rhode Island, U.S.A., where it has been carried out for a couple of generations. In my " Report on the Poultry Industry in America," it is stated* that " within half a dozen miles of Little Compton in every direction there are scores of farms where poultry are kept and raised in large numbers. Hundreds of poultry houses can be seen in the course of a mile or so, and it is estimated that half a million hens are kept within that radius. . . . The methods adopted and the houses used are wonderfully uniform, almost monotonous. But these afford an example of what can be done in practical poultry-keeping over a long period of time, for the section has been strong in poultry for sixty years, though the increased production has been most marked within the last two decades." The farms are usually from 60 to 120 acres in extent, comprising both pasture and arable land. On the former stock are fed or the fields cropped for hay, and grain is grown on the latter. As an example of what is done successfully, on Mr. F. Almy's farm of 120 acres at the place named, 1,800 laying hens were kept at the time of my visit, and 3,000 chickens had been reared that year. Forty-

* London, 1906, p. 41.

five acres were in use for the poultry, and the rest under crops. Another farm in the same township, owned by Mr. W. N. Sissons, was of 65 acres, whereon were 1,500 laying hens. Of this system more is said as to detail in Chapter VIII.

Fox Preservation.—There can be no question that the preservation of foxes for hunting purposes has had a most repressive effect upon poultry husbandry. Frequently I have been informed by farmers, when advocating greater attention to poultry, that the loss would be so great, and the bad feeling engendered so considerable, that they did not think it worth their while to run the risk of one or the other. In other instances, not a few of those who have made the attempt have had constant and serious losses in this way, without any compensation at all, or receiving but a moiety of what they claimed, and even then given in a grudging fashion. The actual loss every year must amount to a very substantial sum. That, however, is infinitesimal as compared with the check to increase of the industry which would otherwise have taken place, to the great benefit of rural residents and the nation at large. A prominent Cheshire farmer recently stated that the number of poultry on farms could be trebled without material increase of cost were it not for foxes. It is undoubtedly true that a few of the hunts meet claims made upon them promptly and with a moderate amount of fairness. That, unfortunately, is the exception. The larger number pay upon a totally inadequate scale, far below the real value, and after delays which are very annoying. Some there are which go even beyond this. They have refused claims made altogether, or only pay those sent in by farmers over whose land they hunt. As a result, a great amount of bitterness has been engendered, and strong action taken on the part of such as have suffered in this way, which will assuredly increase unless those for whose pleasure foxes are preserved are willing to pay proved claims for poultry killed, and to the full extent of the loss incurred. If hunting men are unable to do this, their sport is assuredly doomed. Few there are who desire to see that take place, but the tendencies are all in this direction. Should the time unhappily arrive when the problem of fox-hunting *versus* poultry husbandry has to be decided—that is, the interests of the few or the many—there can be no question the last-named must come first, in view of the national food-supply. Hunting men will only have to thank themselves for the result. It must be remembered that this sport can alone, in a thickly-populated country, be enjoyed on sufferance. Anything which gives the sense of unfair treatment is bound to end such a privilege. A large number of foxes have

PLATE I.

Photo] [*J. H. Robinson.*

RHODE ISLAND COLONY HOUSES.

been killed, and the number will increase. They are vermin, and it is within the right of anyone to destroy them as a nuisance Attempts have been made to bring about an understanding with hunts, but these have largely failed, owing to the attitude of these bodies. Poultrymen have suffered much in the past, and their patience is wellnigh exhausted. Larger farmers may regard the loss of their wives' poultry with equanimity, but it is a matter of life and death to small farmers and allotment holders. It is stated, with every appearance of truth, that were the cubs properly fed in the rearing season, and the grown animals in winter, much of the difficulty would be removed. If that be so, the blame lies wholly at the door of those responsible for preservation. A further point is that independent men who make claims receive a full and prompt settlement, whilst those to whom the loss is really of serious moment are refused, or offered inadequate compensation. That gives a sense of wrong which makes for bitterness and retaliation.

Poultry in Orchards.—It is now many years since I first called attention to the value of poultry on the vineyards of South-Western France, as well as in the orchards of Normandy, where fowls are not alone found profitable, but render great service in destruction of parasitic life which preys upon the bushes, trees, and vines. To some extent there has been development in this direction since that time, but to a very limited degree. I find from the agricultural returns that in 1912 there were upwards of 320,000 acres under fruit in England and Wales, which ought to maintain fowls to an average of at least five adult fowls per acre; and the same might be said of hops, of which there were upwards of 34,000 acres. How many are now maintained it is impossible to surmise.

One example of what might be duplicated throughout the fruit-growing districts is that of the farms owned by the Messrs. John Chivers and Sons, of Histon in Cambridgeshire, which firm has 1,000 acres under fruit grown for the purpose of jam-making. Upon these they are maintaining about 5,000 laying hens, the eggs from which are mainly utilized in the factory. The principle adopted is to place the houses for adult fowls, whether layers or breeding stock, and also the chickens in coops and brooders, in the orchards, giving them free range. The same is done on the strawberry-beds at certain periods of the year. No wire netting is used. Thus the conditions are essentially natural, extensive, not intensive. The result is that everything is favourable in the extreme. So abundant is the food obtainable that the cost is reduced to a minimum, and the manager informed me they could scarcely give the birds little enough, as they could practically obtain as much as they required—that is, the older birds. During the early stages, such would not apply to chickens. It means that what would be wasted is thus utilized, and the food cost, which is ever the greatest, is very low indeed. Such must profoundly affect the financial result.

FIG. 1.—POULTRY IN ORCHARDS.

Destruction of Parasites.—This is not all the benefit derived, although of considerable importance. Apart from all other considerations, fowls render a great service in checking the increase of parasites, which multiply enormously and are very destructive where cultivation is carried out on intensive lines. Such has been the experience of the Messrs. Chivers, as of other fruit-growers, causing considerable loss. The fowls have rendered very great service in this direction. As proof of what is here stated, experience has shown that on the larger fruit-trees commonly attacked by the winter moth, it was a usual thing to find fifteen to twenty moths on the grease-bands. Where fowls are in the orchards these are almost entirely cleared, and if any can be traced, they do not at most exceed one or two. It is well known that land planted with strawberries following wheat is often devastated with the crane-fly. The effect of allowing fowls access thereto prior to the fruit-farming has been to practically clear them of that pest, confirming evidence which was given to me in America. The raspberry beetle is very destructive to that fruit, and by eating into the buds causes great loss. As many as thirteen have been discerned on a single head. These pests go down the vines in the afternoons or on the approach of stormy weather, when the fowls, if given the opportunity, devour them. On the 29 acres at Histon devoted to raspberries, the beetle has been cleared by the fowls, to the great gain of the owners. And, finally, there has been no saw-fly caterpillar on the gooseberry bushes where fowls have been run.

Manurial Influence of Fowls.—So far as agriculturists are concerned, there is a further benefit from extensive methods of poultry-keeping—namely, the manurial influence, when production is not beyond the power of the soil to utilize. In Chapter I. an estimate is given as to what would be the total value of fertilizing elements were the farms of the United Kingdom adequately stocked with poultry. An example of what has already been accomplished is found in one section of Belgium with which I am well acquainted. Belgian occupiers realize the value of manure, of which not a drop or particle seems to be wasted. It is freely acknowledged that the fertility of the soil has been raised considerably by the keeping of fowls and ducks. The most noticeable instance is met with in what is known as the Campine district, which extends from the city of Malines east and north to the Dutch frontier. At one period this was an arid sandy plain, covered with fir-trees and incapable of cultivation. Some of it remains in the same condition, but considerable portions have been brought into use as market-gardens. The story is deeply interesting and highly suggestive. About forty years ago poultry-breeding was taken up by the peasants in this district on a somewhat extensive scale, primarily with the object of raising chickens for sale to the fatteners on the other side of Malines. The land was of little use for other purposes, and, although there was not much natural food for the fowls in the soil, it was dry, the fir-trees provided abundant shelter during the hot days of summer, and a moderate amount of insect life was obtainable. Eggs, also, were and are produced in large quantities throughout this district, though on such soil they are smaller in size and inferior in quality to those from hens kept on the richer lands. In the summer of 1897 I paid a visit to the district. Already a very marked change had taken place. The land near to Malines had been so enriched by manure from the poultry that it was under cultivation. For a distance of about five miles from that city the trees were cleared, and market-gardens for production of asparagus and vegetables formed upon the old woodlands. At that time it was freely acknowledged this result was largely due to the fowls, which were being bred in greater numbers all over the Campine country.

I was not, however, prepared for the developments which had taken place twelve years later, when the district was again visited. At the earlier period I drove to Rymenam, Keerbergen, Putte, and Grasheide, through the fir-woods, in which were cottages of a very humble type, attached to each of which were about 12 hectares (nearly 30 acres) of land, with very small clearances around the dwellings, little more than gardens. The people depended chiefly upon poultry-rearing for their incomes. At one place visited—a small inn—I was told that the owner had already by the month of June sold 350 birds, and had 400 more for disposal. In the previous year his sales of poultry amounted to 4,000 francs (£160). At Grasheide I found a school-house in the midst of fir-woods, which came right up to the buildings on all sides. The teacher, M. Vanden Borchacht, reared about 4,000 chickens every year. By 1909 the whole aspect was altered. As we drove in the month of October to the places named, it was to find the fir-trees gone and the land under cultivation. Market-gardens, grain, and roots, have taken the place of fir-woods, owing to the improved fertility of the soil as a result of poultry kept thereon during a single generation. After the trees are removed it takes about two years to bring the ground into good condition, and, of course, it is capable of further improvement.* Unfortunately, as shown below, prosperity has led to intensification, by which the manure became excessive. That, however, does not affect what is here set forth as to the value of fowls for improvement and fertilization of the land. And in respect to uncultivated areas, this aspect of the case is supremely important. Some further evidence is given in Chapter XVII.

Running Fowls.—Originating in the North of England, so far as commercial poultry is concerned, a system has been adopted which is capable of wide extension, though specially suited to combined agricultural and industrial areas, such as the manufacturing villages of East Lancashire and West Yorkshire.

* *Vide* "Report on the Poultry Industry in Belgium," by Edward Brown, F.L.S., London, 1910, pp. 14 and 15.

Arrangements are made between the poultry-keepers, who are usually operatives, and farmers, for the former to place poultry houses out upon the farmers' fields, and to maintain an agreed number of fowls thereon. The advantages of this system will be apparent in that, not only does the farmer receive rental for the land over which the fowls are permitted to run, but also he insures for his land in a very cheap way a considerable quantity of manure, thus improving the value of his crops; whilst, on the other hand, the poultry-keeper, who is usually landless or has only a small allotment, is enabled by the system here described to keep a very much larger stock of fowls at less risk than if he were obliged to rent the land. The method is more suitable for grazing counties than where arable lands prevail. There is no reason, however, why in every grazing district the plan might not be followed, and it would probably have wide-reaching influences if properly carried out, in that, apart from the immediate benefit derived, it would give opportunities to cottagers for keeping poultry and improving their position.

To carry out this system, arrangements should be clearly defined. The poultry-keeper must move his houses about in accordance with the wishes of the farmer, for if a house were allowed to stand too long in one place the herbage around would be injured or destroyed. On the other hand, the farmer must give access to his fields, which occasionally involves trouble. With mutual desire, however, to meet each other these difficulties can be overcome, and it is found, from the fact that the system is increasing, though somewhat slowly, that the advantages of this system are receiving recognition. Under these conditions portable houses are preferable, in that the manure is more evenly distributed, and all danger of tainted soil is obviated, whilst the supply of natural food will be more abundant. As a rule the number of fowls should not exceed ten per acre on the land actually occupied. The rent charged is usually 6d. per bird, or 10s. per flock of twenty-five, per annum.

Utilization of Waste Lands.—In the United Kingdom are nearly 30,000,000 acres of land not under cultivation, divided as follows:

	Under Cultivation (Acres).	Not Cultivated (Acres).	Total Land (Acres).
England	24,414,493	7,979,717	32,394,210
Wales	2,760,197	1,989,454	4,749,651
Scotland	4,821,334	14,249,132	19,070,466
Ireland	14,673,778	5,573,419	20,247,197
Totals	46,669,802	29,791,722	76,461,524

These figures do not include the Isle of Man and Channel Islands. A considerable portion of the uncultivated land consists of mountains and bogs, which could not be used in any way. Among the remainder, rough grazings form a large part. In England and Wales these comprise 3,774,655 acres, or nearly half. In Scotland the proportion would be much larger. Probably there are in the four countries 10,000,000 acres that could be used for poultry, which would contribute materially, as in the Campine country (see above under Manurial Influence) to their improvement. I am convinced that there is a great future in this direction. The breeding of all classes of poultry might be developed thereon, not alone for production of eggs and of flesh, but also the hatching and rearing of stock birds raised under conditions that would make for constitutional vigour, and, if sold to farmers and others living within the cultivated areas, would do much to counteract the tendencies towards degeneration which mark our present methods. Pullets might be bred and sold in this way at five to six months old, to be replaced by others annually or every second year. As the cost of production would be small, the prices at which they could be sold would encourage a large and profitable trade to all concerned. Some areas would be excellent for ducks and geese, and scores of thousands of turkeys might be bred on the dryer hill-lands, to be sold off for fattening in the autumn.

Specialized Poultry Industries.—There are several branches of poultry husbandry in which there is a large measure of specialization, in that these are general over given areas, and that the methods adopted cannot be followed by ordinary farmers who do not make poultry-breeding one of their leading objects. These include the breeding, rearing, and preparation for market, of chickens, ducklings, goslings, and turkeys, all of which are treated fully in the respective chapters. As a rule turkeys are kept all their natural life on the place where they are hatched; therefore that branch is self-contained. Such is not the case with chickens—at least, where the finest specimens of market birds are produced. The finishing process, known as fattening, is distinct from that of hatching and rearing. With regard to ducklings, those who keep the breeding stock sell eggs to men who specialize in hatching, rearing, and fattening. Whilst with goslings, though that business is less than was at one time the case, the rearing and final fattening are usually in distinct hands, and carried out under totally different conditions. Dualism in this way has many advantages, distributing the earnings and preventing concentration and monopoly. A further point is, in every branch of table poultry, that the climatic and soil conditions must be favourable, upon which more is said below. Within these limitations the country as a whole has possibilities of great development. In this direction also there is a great opportunity for production of large fowls for sale in the winter months, on similar lines to what is done in America and Belgium, as also of milk chickens.

District Poultry Industries.—Several branches of poultry-keeping have attained their greatest development as a result of general adoption over a given area, which are small or large in accordance with local conditions. That is specifically the case with the production of table poultry, whether in this or other countries. The evidences are that the success attained is largely dependent upon such being the system adopted. In connection with egg production the same is not necessary to an equal extent. That branch is of more universal application to the farming of any section of the country, whether it be near to or remote from the consuming centres. It is for this reason we find poultry-keeping with a view to eggs met with in almost every county. It is also true that the demand for eggs would appear to have grown much more rapidly than that for chickens and other classes of poultry, which remain a luxury to the greater number of our people, whereas eggs form a part of the food in all but the poorest households.

The advantages of uniformity in production are very great, and conducive to success. These may be briefly stated as follows:

1. Reputation counts for much in all departments of trading, and in itself generally is creative of demand.

2. The force of example and the influence of competition are powerful factors, doing much to improve and maintain the quality of any product.

3. Specialized work, such as fattening poultry, requires skilled operators, and the work must be done on a scale to afford these men adequate rewards.

4. Where production throughout a district is general, the sale is greatly simplified, whether that is by means of co-operation or through the ordinary trade channels. Uncertainty and irregularity account for much loss and many failures. Unless the produce of any district is voluminous enough to make handling profitable, prices must be low, by reason of the fact that the relative expenses are in inverse ratio to the quantity.

5. Under the conditions here set forth, good quality produces much better returns as a result of the reputation already referred to, provided that a reasonably adequate supply is available.

Poultry Farming.—In these days of huge enterprises, of combinations and trusts, the idea of big poultry farms, where laying hens could be kept by the thousand, where eggs could be produced by the hundreds of thousands, or chickens turned out by the gross every day when they are most in demand, has fascinated many minds. Flaming accounts have been published of such enterprises, generally when only partially in being, expressive of the hopes rather than the accomplishments of the promoters. For sixty years attempts have been made in that direction, but without exception, save in duck-farming, these have failed purely as a market proposition, mainly because livestock do not lend themselves to "factory" methods. Or, as Dr. Raymond Pearl has wisely said: "Chickens are not machines; they are living creatures. A poultry plant is not a factory. It partakes much more of the nature of a girls' boarding-school, with a strong leaning on the part of its inhabitants towards suffragette doctrines." The expenses are too great for the returns. If establishments like these could be made a commercial success, a new development of poultry husbandry would present itself, and the provision of a more regular supply of eggs and chickens would be of the greatest benefit to the nation at large as well as the individuals concerned. The fact, however, is that no one of these poultry farms which restricted itself to supplying the market with eggs and poultry for consumption has ever been permanently successful. I have visited many such, both in Europe and America, with the result stated.

The Place of Poultry Farms.—Those which have succeeded have done so by reason of the fact that their largest source of income has been by sale of stock birds, eggs for hatching, day-old chicks, etc. Of these there are a goodly number in Britain, and the owners in some cases have made handsome competencies. It is unnecessary to name them, as their advertisements are to be found in all poultry publications. The fact is these are poultry-breeding farms, holding a similar relationship to food-producers as do the seedsmen to farmers, or the nurserymen to fruit-growers. That they contribute eggs and poultry for food to some extent is true, yet the output is a surplus. As an example, at one of the most heralded American poultry plants, which some time ago published a balance-sheet, out of a total sale in one year equal to $27,000, more than half the returns—in fact, nearly 55 per cent.—were for other than market supplies. In other cases the percentage has been much greater.

Here we see what is the true place of special poultry farms, or, to use a better term, breeding or stock farms. That they are necessary and occupy an important position is unquestionable. Their success, however, depends almost entirely upon development of a trade in stock birds, eggs for hatching, and day-old chicks, by means of which they serve a valuable purpose in supplying a higher type of birds, directly or indirectly, giving that attention to improvement of the stock which can scarcely be undertaken by the farmer or ordinary poultry-keeper, who is willing to pay a good price for what they have to sell. Such is entirely different from breeding for exhibition, as the main object is a higher standard of productiveness. Every encouragement should be given to those who desire to undertake what is an important contribution to the general well-being. At the same time it must be realized that those who enter upon such a pursuit must have special qualifications, and plan their operations to meet demand in the directions indicated. Further, where the work is to be a means of livelihood it must be upon a sufficiently generous scale to yield an adequate return. What we want to see is the increase of these breeding farms, concurrently with that of commercial poultry husbandry, throughout the country, in which direction there is abundance of scope, so long as the true basis is recognized.

Breeding Centres.—It was, I believe, my own suggestion which led to establishment of the first breeding centres in Ireland. That was in 1889. The object was, in an impoverished country where there were few places that good utility stock was produced, and, moreover, the people whom they were destined to serve could not afford commercial prices for such stock or eggs for hatching, to supply reliable stock or eggs for hatching at a cheap rate. Hence, unless some such system were adopted, that improvement of the various classes of poultry, which was of vital necessity if any progress were to be made, was impossible. The influence has been enormous. It is not too much to say that the great advance made in actual production has been largely influenced by these stations. Those who are able to compare the class of poultry seen over the greater part of Ireland in, say, 1890, with what now prevails, will be able to realize how great the change has been. The system here referred to has been adopted in Denmark, Germany, Holland, Russia, and Sweden, and is now being extended rapidly in Scotland. Where by impoverishment of people from any cause it is found desirable to expend public money for their uplifting, the establishment of such centres is fully justified. I found in Germany that something like 3,000 of these subsidized centres have been formed, as a result of which private enterprise is subjected to a competition which cannot be met, for the reason that the prices charged for stock, eggs, etc., are unprofitable. To some extent this is compensated by the premiums granted, but not wholly so. Later observations in Holland have revealed a like result. In this connection it should be remembered that in nearly every section of Britain south of the Grampians there have been and are a large number of private poultry-breeders, who have taken a great share in the improvement of economic races of domestic poultry, before public authorities came into it, the destruction of whose businesses would be an act of injustice.

Day-Old Chick Trade.—One of the most remarkable developments of recent years has been the rapid growth of a trade in day-old or baby chicks. Although the purchasing of eggs for hatching is still a huge business, yet it is often very unsatisfactory both to the vendor and buyer. The latter merely obtains for a money payment the possibility of getting a batch of chicks, and is apt to be disappointed if the result is not what he expected. The business also lends itself to chicanery and trickery on both sides. As a result complaints are rife. About the year 1895, when on a visit to France, I found two establishments at which a large business was being done in the sale of newly-hatched chicks, which were found to be able to stand a long journey without apparently suffering therefrom. That example was speedily tested, and has grown greatly, so much so that hundreds of thousands of these birds are sold every season. The purchaser pays a little more for what he buys, but receives live birds, not eggs. More information in detail is given in a later chapter. That the business is capable of great extension cannot be doubted. There are, however, dangers which require to be avoided. Too often those who undertake the work of hatching, in their desire to obtain early eggs in order to keep their incubators full and meet the demand for birds, do not pay sufficient attention to the age and constitutional vigour of the breeding stock, often obtaining eggs from immature fowls kept under bad conditions, with the result that there is degeneracy in the progeny. This practice may do much harm, and has already done so. It is not enough to send out chickens that will arrive safely.

Intensified Methods.—That the future will see a great increase of intensification in poultry husbandry is evident. In fact, such must be true if the needs of a rapidly growing population are to be provided for That can only be successfully accomplished if the balance of Nature is maintained between animal and plant life. It is, unfortunately, true that many of the "bird-cage" methods which have been advocated carry the seeds of their own destruction. We could ignore the extravagant claims put forth if it were not that many people are misled, and venture their all in this way. Were half the statements true, the rest might be forgiven. The disproportion, however, between fact and fiction is very wide. These abnormal and unnatural methods are suited for backyard poultry-keepers whose space is very limited, and as a supplemental pursuit or a hobby to meet the needs of their own households, provided that the closest attention is paid to management in every way by giving the birds as much exercise as possible, and renewing the stock every one or two years, not attempting to breed from birds kept under these conditions. One reason why so many artisans take up poultry-keeping is to supply the requirements of their households. Beyond that is a desire to have an alternative, if only a partial, source of income in case of loss of work or other causes. As a means of livelihood it cannot be admitted that the system may be conducted on a large scale. Apart from the cost of equipment and labour, there are other considerations. Experience in America and Belgium show that degeneracy leads to disease and loss. That is not the way to build up a profitable and permanent industry.

Effect on the Stock.—In this connection a very serious condition of affairs has to be faced—namely, the effect of continued breeding under highly intensified conditions upon the vigour of the stock. The claim has been made that to succeed intensively it is necessary to buy stock from birds which for generations have been bred in that manner. That is the way of failure, and explains in part the high average of mortality among chickens bred and raised on intensive lines, in which many poultry farms must be included, both in Europe and America, and of which the disastrous epidemic in Belgium in 1912 and 1913 is an example. What seems evident is that it will get worse, and not better, until the true facts of the case are realized. In certain directions we can intensify methods up to a given point. For instance, laying hens can be so kept and profitably. They are usually more productive than upon farms. So long as they are not bred from, and are killed off when their work is done, no harm results. Table chickens and ducklings may also be profitably forced for early maturity. In neither case is there any question of transmission of influence. What has to be kept in view is that—although during the infantile stages chickens may be reared on fairly intensive lines, and such may be continued if they are destined to an early death, also that laying hens may be kept thickly together—it is of supreme importance that breeding stock shall have sufficient range, affording them opportunities of abundant exercise, together with hygienic conditions and natural food, so as to make for constitutional vigour which will be transmittible to their progeny. And, further, it is essential that chickens during the adolescent period of development shall have plenty of space if they are destined to be breeders or layers.

What is necessary, therefore, is that, for the permanent success of intensive methods, the breeding stock must be on range, and that those chickens which are to be reared to adulthood shall be given an abundance of space during the post-infantile period of growth. Such imposes a restriction which is unavoidable and must be recognized.

Bantams.—There is one branch of poultry husbandry, for in such may be included provision for household needs, which in this country has not received attention—namely, the keeping of bantam fowls for the sake of their eggs and flesh. Hitherto they have mainly been regarded for their ornamental or exhibition qualities, although bantam breeders have frequently claimed that in relation to the space occupied by them, and the food cost, as compared with the number of eggs and the quantity of flesh produced, they are among the most profitable of domestic fowls. The eggs are small in size, as the birds are in body, but both are very fine in quality. As pointed out in my "Report on the Poultry Industry in Belgium," the keeping of these birds by suburban and urban residents is much encouraged in Belgium, for the reason that, as the products are not marketable, there is not the temptation to sell, and therefore the children get them, which is a great gain. Multitudes of people living under the conditions named could keep bantams with profit for supply of their own tables. A further point is that they are less likely to be a nuisance to neighbours than larger fowls.

Food Cost and Prices.—That the poultry industry in the United Kingdom has been built on cheap foodstuffs cannot be questioned. Had the high prices of the seventies been maintained, it is improbable that the advance made would have resulted. Any serious increase in food cost would have considerable influence in checking development. As an example, I was informed in Sweden that the cost of producing eggs was 1s. per 120 greater than in Denmark, owing to duties upon imported grain. Taking 1901, the minimum year as to prices of wheat during the present century, I find the actual and average increases of the three leading classes of grain and of imported eggs to be as follows:

	1901. Per Imperial Quarter.	1911. Per Imperial Quarter.	Increases per Imperial Quarter.
	s. d.	s. d.	Per Cent.
Wheat	26 9	31 8	18·38
Barley	25 2	27 3	8·28
Oats	18 5	19 10	2·26
Three grains	—	—	10·54
	Per Great Hundred.	Per Great Hundred.	
Eggs	6 5	8 4	29·87

Thus it will be seen that, whilst the advance in cost of foodstuffs averaged slightly over 10½ per cent., which would be in excess of the fact, as the cheaper foods would be used, eggs increased by nearly 30 per cent. in the same period, so that the advantage to the producer is very considerable. It is always safer, however, to take two quinquennial periods, and the following table is quoted from the *Illustrated Poultry Record* :*

1901-1905 AS COMPARED WITH 1907-1911.

	1901-1905. Per Imperial Quarter.	1907-1911. Per Imperial Quarter.	Increases.	
			Price.	Per Cent.
	s. d.	s. d.	s. d.	
Wheat	27 11	32 7	4 8	16·71
Barley	24 0	25 7	1 7	6·6
Oats	17 11	18 4	0 5	2·32
	Per Great Hundred.	Per Great Hundred.		
Eggs	6 9	8 0	1 3	18·52

The myth is thus disposed of that the cost of production is relatively higher than the increased price of eggs.

Co-Operation.—A factor which is exerting great influence in relation to poultry husbandry, in some countries more than in others, is combination on the part of producers so far as the sale of their produce is concerned. That is especially the case in Denmark, Holland, and Ireland, and is being developed rapidly in the remote districts of Scotland. To a much more limited extent has this form of co-operation been applied in England and Wales, Germany and Sweden. In other countries the trade is mainly in the hands of merchants. That it will be adopted to a much greater degree in the future is apparent, when producers have been educated in the principles and understand the advantages of this system, which will transfer the centre of

* November, 1912, p. 58.

gravity from the trader to the producer, to whom it is a question of supreme importance, and who, as he bears the responsibility for quality and expedition in marketing his goods, will realize much better returns than has hitherto been the case. It is necessary, however, to remember that in the three countries first named immediate consumption is comparatively small, and that the bulk of the eggs and poultry must be exported if the business is to be successful. Hence there are no competitive factors to take into account. It is the latter which cause co-operation to make slower growth in what may be termed consuming countries, owing to the local demand for supplies. For example, I do not know of any county in England, and only two or three in Wales, which provide for their own needs in eggs and poultry the entire year round. In a very large proportion consumption is several times greater than production. As a consequence, producers and consumers are so near to each other, and prices are so good, that there is no need for, and limited opportunity of organization on, co-operative lines. In a number of rural districts societies have been formed, and proved of the greatest benefit. That is not the only influence. Traders have been compelled by fear of co-operation to revise their methods, to pay better prices, from which poultry-keepers have obtained great benefits and consumers received a higher grade of supplies. It is not the trade done which counts, but the influence exerted. Even societies which have not succeeded as business propositions have paid their cost a hundredfold in this manner. As time goes on, and especially as small holdings and allotments increase, co-operation in its application to marketing will find greater opportunities.

Instruction and Investigation.—With the growth of poultry husbandry, the need for instruction in principles and method on the one side, and investigation into problems which arise on the other, become more and more apparent. One aspect of this question I have already presented in another place.

"In every aspect of life, advance from natural to what may be termed artificial conditions involves considerations, and often difficulties, which were unrealized, or, if known, regarded as unimportant. That fact is seen in no direction more than in poultry breeding and production. With enlarged vision questions assume a totally different phase. There is, however, a further point—namely, increase of numbers and modification of methods are themselves frequently contributory to checking attainment of the object in view, mainly by weakening the physical resistance. What would have been easily combated under more natural conditions exercises a powerful influence.

It is not until men have experienced the loss arising from abrogation of that balance which Nature maintains for preservation of all organic life, that they have to confront problems the solution of which are essential to success. We require to bring into our purview the marvellous advance of pathological knowledge which has marked recent years, to study how far genetics and Mendelian theories will assist practical poultrymen, and to inquire into the relationships of breeds to their environment. It is the business of the investigator and experimentalist to probe these questions, to discern as far as possible how the equilibrium may be restored, to discover the way of avoidance of whatever is antagonistic, to apply enlarged knowledge in other directions to poultry-breeding, and to seek for shorter cuts to the end in view, as it is of the instructor to bring within the purview of those engaged in the pursuit the result of such inquiries, together with the experience of others."*

Unhappily, the United Kingdom, though France was first and England second in provision of systemized poultry-teaching, has been far behind in both that and investigational work. It is North America, both Canada and the United States, that has made the greatest advance in each direction. Every country that seeks to develop poultry husbandry must follow these examples, and by elementary and advanced poultry instruction, together with careful scientific research and practical experimental work, place the industry on a firm and sure basis.

* Presidential Address, International Association of Poultry Instructors and Investigators, London, July, 1912.

CHAPTER III

THE BREEDS OF POULTRY

THAT purity of race in fowls or other poultry makes for progression cannot be disputed. Nature herself works on those lines. Natural selection, as we understand it, not alone tends to elimination of the least fit, in so far as vigour of constitution is concerned, but also to inducing fixity of type, even to coloration of plumage and to general external characters, the object and purpose of which are unknown, under equal conditions of climate, soil, and food. In that way uniformity is secured over a greater or lesser area. It is to this fact we owe the evolution of many of our breeds of poultry, or at any rate the basis upon which these races as we know them to-day have been formed. What, however, has been an even more powerful factor, even if supplemental to natural influences, is that which we call "artificial selection"—namely, the compulsory and often arbitrary mating of poultry by man with some special end in view. To that we owe many breeds or varieties. The production of these is by no means terminated. Both natural and artificial influences must be taken into consideration. Often artificial selection is disregardful of the environment, which in itself induces modifications the breeder is unable to overcome, and which change the type to a considerable extent.

Pure Breeds the Basis.—It would be a waste of time and space to discuss whether pure-bred stock is preferable to mongrels. The entire position of the United Kingdom as a great breeding centre has been built up on its pure races of horses, cattle, and other varieties of stock. If mongrelism were to be preferred, then all the efforts of breeders for the last hundred years have been in vain, and the sooner we abandon the system the better will it be for all concerned. Whilst it may be conceded that sometimes pedigree and high-class breeding is carried to an extreme, and that competition for prizes does not encourage productiveness, the benefits of pure-bred animals and birds are too apparent to need repetition. What applies in the larger branches of stock equally does so with poultry, and I believe that it is imperative for pure races to be maintained. Without these we should waste our energies in breeding, whereas now we can conserve the qualities for which we are seeking, and by judicious breeding obtain results which would have been impossible under other conditions. External points should be regarded as determining the internal qualities of any breed only in so far as they show that it has been bred to a given type. The colour of plumage is no indication as to whether a fowl is a good or bad layer, nor are the fifth toes on the Dorking and the Houdan related to their edible qualities. But correct colour of feathering tells of continuity in breeding, and although there are as good table fowls as the Dorking, and better than the Houdan, who carry no supernumerary toe, we know that when these fifth toes are met with that is a fowl in which one or other of these races has had a share. Even where what may be regarded as purely economic qualities, such as egg and flesh production, equally as to volume and quality, are alone sought for, it should be clearly understood that the basis must be pure stock, for from these we obtain continuously the highest results. In this direction there is no need to quote examples. The fact is obvious to all. Even where the line of greater immediate profit may be by crossing—and I admit that is often the case—such crosses should be of distinct breeds.

Economic Qualities.—It is not my purpose in the present volume to deal at length with the various races of poultry. The utility as distinct from the purely fancy breeder will find full descriptions of breeds and varieties both as to external characters and productive qualities in "Races of Domestic Poultry."* Here I briefly summarize the distinguishing features of each breed. As the main purpose is in respect to the practical values of poultry, the first consideration must be that each breed is possessor of qualities that conduce to profit, either by the number of eggs or the quantity of flesh produced in relation to the cost. It is the margin that counts. A hen that merely lays enough eggs during the year to meet her food bill is useless. Her room is better than her company. And, on the other hand, if, say, a duckling costs in feeding as much as it will realize on the market, it has no real commercial value. Therefore we must carefully study the relative productiveness as indicated by actual experience, not in the abnormal, but the average or mean of its race.

* London, Edward Arnold, 1906.

Exceptions are always interesting. They have, however, only a limited influence. In the light of these considerations I submit the following:

Egg Qualities.—In the next chapter various questions are discussed as to what has been and is being done in order to increase the fecundity or laying property of the domestic hen. My present purpose is to indicate what are the qualities in this direction of the breeds known to us—that is, under average or ordinary conditions; for, be it noted, what may take place within a favourable environment, and where the management is specially good, will not be found everywhere. Even in the members of a single flock, descended from the same parents, hatched, reared, and fed identically alike, there will be great variations. We have to regard the mean, by which is meant the average tendencies. That there are such is freely admitted.

The first point to be considered is whether the eggs produced are of a marketable size, meeting the somewhat arbitrary requirements of consumers. Upon this more is said in the succeeding chapter. There are prolific breeds which, from the fact that the eggs laid by them are small, are not of equal economic value to those that lay a smaller number, except for home consumption.

Second is the number of eggs laid during the first and second laying years, which form the period of profit—that is, for sale as human food. The food cost of a hen is equal to from forty to seventy eggs per annum, according to the conditions under which it is kept and the prices that can be realized. Therefore, profit will depend upon the number produced beyond what will meet the charges for maintenance. A flock of hens which merely discharges the food bill is of very limited value where eggs are the main object. This fact affords an explanation why such strenuous efforts have been put forth to increase the productiveness of various breeds of fowls.

Third is the time of year when eggs are produced. As is well known, this commodity is much higher in price from September to February, the time of maximum value being in November, than from March to June, the time of minimum usually falling in April. A hen which only lays when eggs are cheap requires to yield a much larger number than if these were wholly or partly produced in the dear season. Ten eggs in November will realize as much as twenty or twenty-five in April. Here, again, further information will be found in Chapter XXI.

Fourth as to colour of shell. On some markets—and those usually the better as to prices—tinted-shelled eggs are more in demand than those which are white in the covering envelope, and sell at higher rates. There are centres where the opposite is true. It is mainly a matter of fashion, though very potent, as there is no traceable difference between them in respect to nutritive qualities. Three reasons in favour of the tinted-shelled egg can be given—namely, that in some of these the yolk is larger in proportion to the total bulk as compared with white-shelled; that the shells are usually heavier and denser in texture in the former, and carry better in transit; and that the breeds which lay the coloured eggs are usually better as winter layers.

Table Qualities.—In respect to flesh properties, these have to be approximated on similar lines, but differing in detail. The points for consideration are—

First, the quantity of flesh, in which respect there are considerable variations. In this direction the distribution of meat is very important. The finest specimens are those in which the breast muscles are most fully developed, as compared with the thighs, the latter of which is darker in colour and harder in texture, owing to a greater proportion of sinew.

Second, the texture and softness of flesh. To some extent this is influenced by the nature of soil on which the birds are reared, and the food given to them. At the same time, some breeds with a large amount of breast muscle are hard in flesh, and therefore not favoured for the best trade.

Third, the bone. This is the most expensive part of the body to produce, and is of very small value. It is not so much the thickness of bone as its consistency. Hard, strong bone, whether thin or thick, takes longer to grow, with a corresponding increase in food consumption. Hard bone is usually found in long-limbed fowls. What should be desired is a soft bone that can be cut through with a knife.

Fourth, the colour of flesh and skin. In nearly all European markets white-meated birds are preferred. These usually have white or blue or bluish-black legs. Black-legged birds generally have grey flesh and occupy the second place. Yellow flesh and skin are associated with yellow legs, and occupy an inferior position both as to quality and quantity of meat in relation to the total weight. In America the last-named have hitherto been preferred, but in that respect a change is apparently taking place.

Fifth, the question of size. As shown in the next chapter, the bulk of body in heavy-laying birds is usually in inverse ratio to the number of eggs produced. Size is, however, important in the meat races, though not wholly the case, for some of the largest breeds are so by reason of excessive bone.

Sixth, a capacity for rapid growth. In that respect soil has great influence. At the same time there must be the capability for quick development.

Seventh, a disposition to fatten, which in large measure is a question of temperament. Restlessness, such as is characteristic of some fowls, means want of responsiveness to this process. A mild, easy-going, lethargic disposition is always preferable, as that tends to flesh development.

It may also be pointed out that the table breeds are usually less hardy in constitution than those which are better as layers, and that we cannot expect to attain ultra-development in both directions at the same time.

So far as ducks and geese are concerned, the above observations generally apply. In addition, however, it may be pointed out that cream- or flesh-coloured bills usually go with cream-coloured flesh, and that some of the best ducks have a blue bean on the tip of the bill. The legs in these are usually dark or very pale orange. These birds have never naturally the pure white flesh and skin seen in the better qualities of table fowls.

Maternal Proclivities.—In spite of the fact that in these days artificial methods of hatching and rearing are general, the question as to whether a breed is a sitter or not must receive consideration. The tendency of increased fecundity is to reduce or suspend the hatching instinct. It is, therefore, a fact that we find what are known as non-sitters exclusively among the heavier layers, as that all the table and general purpose breeds undertake maternal duties to a greater or lesser degree.

Consumption of Food.—Where the object is profit, the question in respect to cost of production is supremely important. So far as poultry are concerned, food must ever be the chief expense. Therefore it is desirable to learn, as far as possible, what is the relative consumption by the different races, whilst recognizing that this must vary considerably, and that the conditions under which birds are kept will have a great influence upon the amount of food eaten. In this direction there is abundant opportunity for careful observations, as the data available is very limited indeed. One fact is evident—namely, that the heavier and larger the body the more food is required for its sustenance. As a consequence, taking a hen weighing, say, 4 pounds, and another weighing 6 pounds, each producing the same number of eggs, from such knowledge as we possess it may be assumed that the food cost will be 40 to 50 per cent. greater with the heavier than the lighter fowl. For example, some years ago M. Lemoine, the eminent French poultry-breeder, found that Hamburghs and Leghorns required $4\frac{1}{4}$ to $4\frac{1}{2}$ ounces of food per diem, whereas the larger Crèvecœurs, Dorkings, Houdans, La Flèche, and Langshans, consumed about 7 ounces, and the huge Cochin, heavy in bone and feather, ate upwards of $17\frac{1}{2}$ ounces in the same period. Probably it is not so much noticed when the birds are at liberty, as there they find a large amount of natural feed. Even then, however, the lighter breeds are usually more active and better foragers. Ducks, geese, and turkeys, are all heavy eaters.

Classification of Poultry. In view of what has been stated above, it is now my purpose to classify the various breeds in accordance with their economic properties. In doing so, the same arrangement is followed which I introduced in 1891, when the first edition of "Poultry Keeping as an Industry for Farmers and Cottagers" was published, as I do not know a better one. Within each of the following sections the races of poultry can be included, though some of these may be near the border line. The following are the divisions:

Fowls.—

1. Egg-producing races.
2. Flesh-producing races.
3. General purpose (egg and flesh) races.
4. Ornamental races.

Ducks.—

1. Egg-producing races.
2. Flesh-producing races.

Geese and Turkeys.—All are bred for flesh, not eggs, except for reproductive purposes.

The terms used above mean that, whilst the egg races carry some flesh, profit is due to the eggs laid; and that in the flesh races the eggs would not be enough, as compared with the flesh, to repay the owner. So far as ducks are concerned, whilst some breeds are profitable layers, flesh bulks to a considerable extent.

A difficulty which here presents itself is selection of breeds to be included in the lists given below. Those who desire to study the question to a fuller extent as to British and foreign breeds will find many of these fully dealt with in "Races of Domestic Poultry,"* which are not here named, simply by reason of the fact that they are either unknown or have not special qualities to commend them to practical poultry-keepers. Therein will be found detailed lists of the colour of flesh, skin, legs, eggs, etc. Under Class No. 4 I name a few breeds of Bantams for such as

* London, Edward Arnold, 1906.

desire to keep these birds for the sake of their eggs and flesh. It may also be noted that some breeds are left out which formerly possessed utility qualities to a considerable extent, but which can no longer make that claim.

Egg-Producing Races of Fowls.—Ancona, Braekel, Campine, Hamburgh, Houdan, Leghorn, Minorca, Redcap, Scotch Grey.

In these the maternal instinct is usually suspended—that is, only occasionally is it displayed. They are generally medium or small in size of body, are active in habit, and quick growers, attaining maturity at an early age. Almost without exception the hens produce white-shelled eggs.

Those indicated by an asterisk are more useful for crossing than when bred pure.

Ancona.—A mottled plumage fowl, in other respects closely resembling Leghorns; small in body, and carrying little flesh; excellent layers of fair-sized eggs; active in habit, hardy, and precocious.

Braekel.—This and the Campine are closely related; the Braekel slightly larger in body, which is, however, small; moderate in flesh qualities except when very young; very prolific layers of large eggs; hardy and active foragers. The majority of so-called English Campines are really Braekels; two varieties, Gold and Silver.

Campine.—Originated on the sandy plains of Northern Belgium; resembles Pencilled Hamburghs, except that they have single and not rose combs; excellent layers of good-sized eggs; hardy and active; small in size of body; two varieties, Gold and Silver.

* *Hamburgh.*—Small-sized, well-shaped body on longish legs, very stylish and attractive; has rose comb and large tail feathers; exceedingly good layers, but eggs below market standard in size; five varieties, Black, Gold-spangled, Silver-spangled, Gold-pencilled, Silver-pencilled; active, fairly hardy, good foragers, and small eaters.

Houdan.—A French breed, modified in Britain; large medium in size of body, broad and massive; plumage mottled black and white; comb divided like a double leaf, and crested; clean legs, pinkish-white, with a fifth toe; fair layers of good-sized eggs; flesh white, and more abundant than is usual in this class; not very active; most successful on light soils.

Leghorn.—Of the Mediterranean type; small-bodied, active fowls of great precociousness, and hardy in the extreme; good foragers and small eaters; legs clean and yellow; flesh and skin yellow, but sparse and of inferior quality; prolific layers of marketable eggs; several varieties—namely, White, Black, Brown, Buff, Cuckoo, Duckwing, Pile, and Mottled; the three first named best in economic qualities.

Minorca.—Also from Mediterranean; medium in size of body, with fair amount of meat; dark legs and grey flesh; excellent layers of very large eggs; not very hardy, requiring favourable conditions in respect to climate and soil; two varieties, Black and White respectively, but latter seldom seen.

Redcap.—Original type of Gold-spangled Hamburgh; similar in colour and markings, not so even in the latter; very large comb; hardy, more especially in hilly districts; prolific layers of good-sized eggs.

Scotch Grey.—Tall and somewhat long in limbs; plumage evenly barred black and white; white or mottled legs; flesh and skin white and good in quality and quantity of flesh; a fair layer of large eggs; moderately hardy.

Of the above, Leghorns hold the premier position, more especially the White variety, for economic purposes, when of the lighter-bodied type, in America and Australia, as well as in Europe.

Flesh-Producing Races of Fowls.—Bresse, Dorking, Game, Indian (Cornish) Game, Malines, Sussex.

These, with exception of the Bresse, are all good sitters and mothers. They are, with the same exception, large in frame of body, carrying a considerable volume of flesh. The Bresse and Dorking lay white-shelled and the other tinted-shelled eggs.

Bresse.—The premier table fowl of France; smaller medium in size of body, but long, with light bone, and a remarkable capacity for flesh development when fatted; flesh white, of the finest quality and texture; good layers of marketable eggs; fairly hardy when kept on range; three varieties, White, Black, and Grey.

* *Dorking.*—The oldest English breed save the Game fowl; body large, broad, and deep, and when viewed sideways almost forming an oblong square; breast well forward, neck and legs short; legs clean, pure white in colour, and carrying a fifth toe on each foot; early but moderate layer of large eggs; five varieties, Dark, Silver-grey, White, Cuckoo, and Red.

* *Game.*—Modern long-legged type considerably modified from original form, and are purely ornamental; old-fashioned Fighting Game medium in size; moderate in length of neck and legs; body broad and deep, with great breast development; large amount of flesh on breast, fine in texture but rather hard, requiring to be well hung before cooking; legs clean, some varieties white, others yellow; variable as layers; eggs very rich; hardy

when bred on range; too restless for confinement or fattening; several varieties.

* *Indian* (*Cornish*) *Game*.—Large, massive, heavy-boned fowls; very long in neck and legs; deep yellow flesh, skin and legs; plump and well-meated breasts, but flesh hard; poor layers of small but very rich eggs; partridge-coloured in plumage, which is very rich; valuable for crossing with soft-fleshed races; very hardy.

Malines.—A modern Belgian breed, following Asiatic type; very large in body, stout but soft bones; short neck; long legs, which are slightly feathered, rosy white in colour; flesh good and abundant, creamy white in colour; a fair layer; three varieties, Cuckoo, White, and Turkey-headed; chiefly used for production of large winter fowls; fattens well; hardy, indolent in disposition.

Sussex.—Old type of fowl bred in South-Eastern England; has sometimes been called the "four-toed Dorking"; body larger medium in size; light bone; capacity for great flesh development, as it is broad and deep, and fattens well; flesh and skin beautifully white, as are the legs; moderate as a layer; fairly hardy, requiring warm soil; four varieties, Brown, Red, Light, and Speckled.

For reasons stated below, the best to be used pure are the Bresse, Malines, and Sussex. The other races, however, are valuable for crossing.

General Purpose Races of Fowls.—Faverolle, Langshan (Croad), Orpington, Plymouth Rock, Rhode Island Red, Wyandotte.

The races named above combine egg and flesh qualities without special development in either direction. What is lost in one respect is gained in the other, so that the balance is equalized. All are large in size of body, with which, however, is an increase of bone, so that they are not characterized by rapidity of growth, though in that respect there are considerable variations. The flesh is not of the first quality as a rule, but two breeds, the Faverolle and some varieties of the Orpington, are near the front rank. All are good sitters and mothers, and the eggs produced have tinted shells. In the main they are good winter layers.

Faverolle.—A French breed originating in Southern Normandy; large and upstanding in body; colour of flesh, skin, and legs, white; the legs are slightly feathered; under the head are prominent muffs, or clumps of loose feathers; the hens are good layers; in flesh they are fairly full, and they fatten well, as the disposition is quiet; hardy and precocious; the coloration of plumage is uncertain, with a tendency to salmon in one variety and dark or black in another.

Langshan.—Here again modern breeding for exhibition has led to great elongation of leg in what is known as the Modern Langshan, which is of small economic value. The original or Croad type is totally different: large fowls on rather long legs, somewhat heavy in bone; flesh grey, fairly distributed and good in quality; legs slightly feathered; excellent winter layers of very dark-shelled eggs; not very hardy, requiring kindly conditions; plumage entirely black, of great brilliancy. There are Whites and Blues also, but purely for exhibition.

Orpington.—Large-bodied, broad and deep, with neck and legs of medium length; originally there was one variety, Black, but that is now bred to a limited extent except for show purposes. The later types, the Buff and the White, are among our most valuable races; fairly heavy in bone; flesh well distributed, abundant and of excellent quality; flesh, skin, and legs, white; fatten well, and are quiet in disposition; good winter layers; upon all but heaviest soils are found very hardy; varieties as above.

Plymouth Rock.—An American breed; large and upright in body, somewhat heavy in bone; fair amount of flesh, which can be largely increased as a result of fattening; flesh, skin, and legs, yellow; good winter layers, but keen sitters and mothers; quiet in disposition and hardy in the extreme; four varieties, Barred, White, Black, and Buff.

Rhode Island Red.—Also of American production, and is largely kept in the State from which the name is derived. Within the last few years it has grown greatly in popularity. Medium in size of body; moderate in weight of bone; flesh, skin, and legs, deep yellow; in meat qualities good, save for the colour; fair layers of large, well-tinted eggs; very hardy and precocious; coloration of plumage a bright red, except the wing flights and tail, which are black; two varieties, Single and Rose-combed respectively.

Wyandotte.—Also American; medium-sized body, with moderate bone; flesh, skin, and legs, pale yellow; comb rose, lying close to the head; flesh fairly abundant and of fair quality; exceedingly prolific, especially in winter, but the eggs have a tendency to small size, and are lightly tinted; very hardy, active, and precocious; there are several varieties, of which the White, Silver, and Buff occupy the leading position.

Whilst all the above are strong in economic qualities, the Orpington and the Wyandotte at present are chiefly in favour.

Ornamental Races of Fowls.—The number of these is legion, and appears to be ever increasing. For such as desire to keep Bantams, as suggested in the previous chapter, it is enough for my present purpose to mention those which are best in economic qualities, and which would be likely to thrive under strict confinement. These are—Rose-combed, Brahma, Leghorn, and Scotch Grey, among English breeds, and the Barbus Nains of Belgium. Those who are not so restricted as to space will find Game Bantams of the older type very productive.

Egg-Producing Races of Ducks.—Indian Runner, Pekin.

Many breeds of ducks could be named both under this and the following sections. It is enough, however, for our purpose to mention those whose qualities have been proved.

Indian Runner.—Small in size of body; very long and penguin-shaped—that is, the neck high above the ground, showing the full line of breast. This has been carried to an extreme in show birds, which are abnormal, and shaped like a champagne bottle; flesh very good and abundant for size; wonderful layers of eggs, which are smaller than usually produced by ducks; good foragers and very hardy; plumage parti-coloured, the neck and sides white, and the body fawn.

Pekin.—Of Chinese origin; long in body, which is somewhat shallow, though broad; owing to the legs being set well back, the carriage is upright; flesh fairly abundant, but does not attain the weight of the Aylesbury, and is slower in growth; the flesh is yellow, the legs and bill a deep orange colour; the duck is an excellent layer; very hardy and active, and a good forager; plumage white, with a strong canary tinge. It may be explained that the American Pekin differs from the English, in that it is not so upright and is whiter in feather.

Flesh-Producing Races of Ducks.—Aylesbury, Huttegem, Rouen.

The same specialization has not taken place in ducks as in fowls, so that the differences are less marked. The above list, however, represents breeds in which flesh qualities are pre-eminent.

Aylesbury.—The great English duck; matures very rapidly indeed, and thus is specially valuable for the spring duckling trade; heavy in body, which is level with the ground, though light in bone, set on short legs of a deep orange colour; the head and bill are long, the latter of a delicate flesh tint; flesh and skin are white; flesh is very abundant and of fine quality; plumage pure white throughout.

Huttegem.—Bred extensively in the Audenarde district of East Flanders, Belgium; of a medium size, flattish on back and narrowish, but deep; light in bone; excellent in flesh and fatten well; early and good layers; quick growers when allowed out on the fields and water meadows; hardy in the extreme and splendid foragers; parti-coloured.

Rouen.—Resembles in plumage the mallard or wild duck, in which respect the drakes are very brilliant; large in size of body, and strong in bone, as a consequence it is slow in development, and only suitable for autumn and winter trade; flesh the finest of all ducks at that time, and very abundant; an excellent layer; very hardy indeed.

Races of Geese.—Embden, Pomeranian, Roman, Toulouse.

The geese named above embrace the breeds of most practical value, although there are others found in different countries.

Embden.—Large in size, with stout bone; deep in body, but somewhat flat in front; flesh of fine quality and abundant; a fair layer, coming into profit early; the young birds mature rapidly, and it is therefore specially suited for the early autumn trade, although fattening to a greater size by Christmas; the plumage is pure white, the bill flesh-coloured, and the legs and feet orange-coloured.

Pomeranian.—Found largely upon the Continent of Europe; known as Saddlebacks in Britain; large in size of body, and stout in bone; not very rapid in growth; when mature carry a large amount of flesh, especially upon the breast, which is fine in quality and texture; a moderate layer and good sitter and mother; very hardy and excellent foragers, especially on low-lying, open lands; the English name is derived from a broad dark patch upon the back and wings, white predominating except upon the head and neck.

Roman.—In Southern Europe, excepting France, geese are smaller in size than farther North. These appear to be descended from the ancient Roman goose, which is medium in size, 8 to 14 pounds; body long and broad, well developed below; long neck and legs; fine head, on which is a small crest; legs strong; it is a prolific layer, and the goslings grow rapidly; the flesh is fairly abundant and good; there are two varieties, one pure white, and the other partly white and partly dark grey.

Toulouse.—Often called the Grey Goose; very large, deep-bodied, and massive, with a prominent breast; head and bill very strong, as is the bone; prolific as a layer, and a non-sitter; flesh abundant; as it is slow in growth, the time of marketing is Christmas; the plumage is dark grey, except the under-parts, which are white.

In view of the demand for smaller-sized geese on the market, the Roman breed might be introduced with great advantage.

Races of Turkeys. — American Bronze, Black, Cambridge Bronze, White.

As in the case of geese, turkeys are bred only for their flesh qualities.

American Bronze.—The largest of our domesticated poultry; long, broad, deep, and massive in body, with prominent breasts; the flesh is abundant, but coarser in texture than the other varieties; hens are excellent sitters and mothers; plumage is very brilliant, and the whole appearance striking.

Black.—Of this there are two kinds—the Black Norfolk and the French Black. Of these the former are seldom seen; in size they do not compare with the American or Cambridge Bronze; flesh very abundant, soft, beautiful in quality, and pure white; the Black Norfolk greatly suffered by loss of constitutional vigour, and the French are also somewhat delicate, requiring favourable conditions; in plumage the last-named is self-coloured, whilst the former is marked with grey.

Cambridge Bronze.—Formed by a cross between the Black Norfolk, an old grey East Anglian turkey, and the American Bronze; large, stout-boned, and deep in body; flesh abundant, very fine in texture and soft, especially upon the breast; it holds the first place upon our markets; it is very hardy; the plumage is a dull bronze, with grey reflections, and lacks the brilliancy of the American Bronze.

White.—Largely distributed throughout Southern Europe; medium in size of body, with good flesh qualities, though not so well developed as are other breeds; fairly hardy; plumage burnished white throughout.

Crosses.—The old notion that crosses are better than pure races has been exploded. The great objections to such a practice are that there is not the same surety for continuity of the valuable and profitable qualities, and that the mixing up of external characters means loss of realizable value for breeding purposes. At the same time, when birds are bred simply to be used as laying stock or for early killing, and not as breeders, it is often found that first crosses, the result of mating suitable races, possess an accession of vigour that is very valuable indeed, making for enhancement of productiveness either in eggs or flesh. It is this loss of virility wherein consists the main danger of breeding on pure lines. About that question more is said in the next chapter. On the other hand, whilst we hear about crosses that have proved successful, nothing is known about those which have failed to yield any better results than if pure stock had been wholly employed. And, further, as a rule farmers and others who mix their flocks, merely introducing fresh male birds annually, often without due regard to what has been used previously, do not obtain greater results than where the breeds are kept pure. It may be that where the latter is the case greater care is taken in selection and breeding.

Generally speaking, it may be accepted as a rule for adoption, that where egg production is the main object the plan which may be commended is to keep pure breeds only, for in this way the proved capacity of pullets in that respect can be utilized and transmitted to future generations, both by selection of the birds themselves and by further use of their parents. Should a cross be desired for any reason, those which have proved their value are—

1. White or Black Leghorn cock mated with Houdan hens.
2. Black Hamburgh cock mated with Minorca hens.

The latter require kindlier soils and not very exposed positions. When this is done, however, the cross-bred pullets should not be used for stock purposes, but fresh matings be made of the same races.

On the other hand, I am firmly of opinion that cross-breeding for production of table chickens and ducklings is often to be preferred, in that the increase of vigour in the young birds is beneficial, enabling them to withstand the amount of forcing that the process entails, and that often such cross-breds are specially rapid in attainment of maturity. Here, again, the basis must be pure stock. The best-growing chickens I ever reared were produced by mating a Faverolle cock and Buff Orpington hens, and I have known equally good results obtained by using the same male mated with White Orpington or Speckled Sussex hens. The crosses to be commended, therefore, are—

1. Faverolle cock—Buff Orpington hens.
2. Faverolle cock—White Orpington hens.
3. Faverolle cock—Speckled Sussex hens.

These are for the production of spring or early summer chickens, to be killed when from twelve to fourteen weeks old and reared on warm soils. On heavier lands I should recommend—

4. Faverolle cock—Plymouth Rock hens.

For the production of large winter fowls the Indian (Cornish) Game is very useful, but, as the chickens are slower in growth, they are not of the same value for an earlier trade. The crosses suggested are—

5. Indian Game cock—Dorking hens.
6. Indian Game cock—White Orpington hens.
7. Indian Game cock—Speckled Sussex hens.
8. Plymouth Rock cock—Sussex hens.

In the case of ducks, excellent results have been obtained by mating a Pekin drake with Aylesbury ducks.

CHAPTER IV

SELECTION AND BREEDING

The first step to be taken by the beginner in poultry husbandry, or by such as desire to introduce a better class of stock, is to choose the breed or breeds which it is intended to maintain. This question deserves careful consideration before a final determination is made. Should it be, as is frequently the case, that there are already other breeders who have proved the adaptability of given breeds to the immediate conditions, and have been successful in their operations, it is a wise policy to build up on their experience, rather than to strike out in other directions. On the other hand, should it be that examples are available of breeds which have failed in these respects, then such classes of poultry should be avoided. In that case, before choice is fixed, it is wise to make careful inquiry as to how any breed has acted elsewhere under similar conditions of soil, climate, and elevation, for in this manner much guidance can be obtained and mistakes avoided. These are not easily remedied at a later stage. The point here submitted is specially important in a highly diversified country like the United Kingdom. Adaptability to environment, therefore, is a supreme consideration where the object is profitable production of eggs and flesh. Such cannot be determined as a question of fancy or arbitrary predilection; these must be left to the amateur and the exhibitor.

Uniformity of Breeds.—In Chapter VI. are discussed questions of climate and soil in their relation to poultry husbandry. I am now dealing with the subject from the other side—namely, as to the breeds to be chosen. In this connection it should be remembered that the unit of variability is the race or group, not the individual fowl. Here may be quoted what I have said elsewhere: * "Enlargement of choice may be a positive hindrance.

* From paper on "Promotion of Poultry-Keeping," by Edward Brown, F.L.S., Report of Dublin Poultry Conference, May, 1911.

Indiscriminate racial selection is, generally speaking, a mistake. A measure of uniformity of the fowls met with over a given area, where the environment is equal, is natural, provided, of course, that the breed or breeds are suitable thereto. France built up her poultry industry in this manner, and later observations have confirmed the wisdom of so doing. Nearly all the most successful developments of recent years have been on these lines. Egg production in Denmark, at Petaluma in California, in the State of Rhode Island, and in Australia; table poultry in South-Eastern England, in Buckinghamshire, in various departments of France, in East Flanders, and in the South Shore district of Massachusetts, have, in each individual instance named, mainly been with one breed, modified here and there by introduction of a second. It may be pointed out that, when such is the case, it is much easier to appreciate the racial values, and a single breed is capable of more rigid and careful selection, generation after generation, than is possible when all sorts are found in a district, whilst the introduction of fresh stock of a high quality is made easier. I submit that the time has arrived when our main effort should not be restricted so much, as in the past, to increase in the number of fowls kept—at any rate over those sections where the most progress has been made, though the United Kingdom could double if not treble its stock of poultry—as to advancement of the productiveness of what we now possess. A good deal has been done in this direction, but much more remains to be accomplished for improvement."

Unity of choice is of primary importance. It is preferable, therefore, as a general rule, to adopt the breed which is mainly found in any given area, and which has proved its suitability thereto, so long as that retains its virility and productiveness. We have sufficient instances to show that changes are required, for races of poultry in process of time become exhausted, as do plants and cereals. Cases in point are the substitution of the Faverolle for the Houdan in the Seine-et-Oise district of France, and of the Bronze American turkey for the Black Norfolk in East Anglia. These might be multiplied, but will suffice to illustrate my point. When that is true, pioneers are valuable in testing new forms, and ultimately should lead to a general transference to the race found most valuable; whilst, on the one hand, indiscriminate introduction of breeds in any district, making for lack of uniformity in the produce marketed, and, on the other hand, retention of a class of bird which has lost its economic value, is foolish in the extreme. That is a species of conservatism which is individually and nationally a distinct hindrance to progress.

Choice of Individuals.—Not alone are there great variations between the races of poultry, more especially fowls, but also differences between individual members of one breed or variety; no two are ever exactly alike. As to many of the causes of such variations, we have no reliable data available. One pullet will often lay double the number of eggs produced by a full sister hatched from the same nest. Some of these differences may be due to the fact that the families or strains have been bred and reared under totally different conditions and for different ends, though not wholly so. This question of variation is deeply interesting, but cannot be discussed here. I deal with it in "Races of Domestic Poultry." It will be enough if I point out that the plasticity of poultry and their responsiveness to conditional as well as selective influences have the effect of modifying both external characters as well as economic qualities, though only partially, thus accounting for the variations met with. For instance, taking one of the modern varieties, say the White Orpington, it would be possible to produce three if not four distinct types. If one breeder set himself to improve the laying quality, and over a series of years selected as breeders those with smaller-sized bodies which have proved to be high in fecundity, mated with males which embody the same quality, he would in course of time evolve a distinctive type. Should another breeder take the same original stock, more especially if the soil conditions were favourable to the purpose in view, selecting continuously for quantity and quality of flesh, for rapidity of growth in the chickens, for softness of bone, and to some extent for size, he would evolve a totally different strain—one in which egg production would be very much lower than that first named. And if a third breeder set out to produce Bantams, he could ultimately attain that object, although it would take much longer to realize. In each of these the racial characters could be maintained pure, the differences being in size, type, and leading productiveness. I do not say that as a question of economics the ends in view could not be arrived at more speedily by the introduction of alien blood. In doing so, however, other changes would probably result, modifying the distinctive racial characters.

Breed versus Strain.—We have been accustomed to hear and read that strain or family is of greater importance than breed. Nearly all pedigrees, human and animal, are built up on the assumption that such is the case. It is often stated that "good laying is a question of strain, and not of breed," which is an assumption yet to be proved. Such declarations, however firmly and honestly they may be believed, do not settle the problem.

The more we prove, the more evident are other considerations. Had the statement quoted been reversed, and made to read that "good laying is a question of breed, and not of strain," it would have been equally uncertain. Such does not, however, settle it, either theoretically or practically. There are considerations involved which lead to the conclusion that a bald statement of the kind quoted reveals but a part, perhaps a very small part, of the truth. My own view is that breed and strain and environment are all intimately associated, as are feeding and general management.

In the absence of definite and reliable information as to the productiveness of fowls in the countries of their origin, it may be assumed that the average in eggs or flesh is fairly even, when the birds are bred in a semi-natural manner, apart from selection on special lines. By this is meant that there are limitations to the changes induced by domestication. It may be accepted that under favourable conditions the number of eggs laid by each individual hen will be multiplied at least threefold, and in other cases the size of body will be increased by 50 to 100 per cent., where the natural food conduces to that result, as compared with the wild progenitor. Whilst there are exceptional layers and fine-fleshed chickens met with in all countries, these are comparatively few, except where careful breeding has prevailed. So far as my observations have gone, these show that, apart from specialization, the great majority of hens kept upon ordinary farms in other countries as well as our own do not produce more than seventy to eighty eggs per annum, and that few fowls are more than 5 to 6 pounds in weight of body. The exceptions met with do no more than prove the rule. In this connection I cannot speak as to Asia, whence we have received the greater number of large-bodied fowls. How far these latter are the results of special breeding or of environmental influences it is impossible to say; probably both have had a share. Up to this point, therefore, it would appear that breed is of lesser importance, for, if what is here stated be correct, it was not until the application of selection on rigid lines, with the object of securing prolificacy or enhanced flesh development, that greater results were attained.

We are, however, at once faced with a difficulty by no means easily overcome—namely, that the introduction of a new type or breed, either by importation or combination of existing races, yields remarkably uniform results. Variations there will always be. Nature works with plastic materials. A hundred influences may bring these about, of which we know nothing. It is well known that a breeder may sell ten lots of pullets of the same breed, strain, and age, to as many customers, every one of which will give different results. He may rear a hundred pullets from the same parents, under like conditions, and the variations in this respect may range anywhere from 50 to 150 eggs; or he may grow fifty chickens, and not more than half a dozen will weigh exactly the same when killed for market. The most reliable results are met with by dependence upon breed rather than strain. A common mistake is made in assuming that heavy laying is modern. More than thirty years ago I was interested in an experiment in which a dozen White Leghorn pullets gave an average of 156 eggs in their first laying year, and that within less than a decade of the introduction of the breed into this country. That could not be, and was not, attributable to strain; other factors must have conduced to the result. Some of these extreme layers are merely mutants. It may be accepted, therefore, that the unity of variability is not the individual, nor is it the family, but the race.

Limitations of Strain.—In speaking of strain or family, it may be well to inquire what is meant by the term. Usually it refers to a few, in some cases very few, generations bred along the same lines. How many of our utility fowls conform to these requirements ? Not very many. Even with these the lineage is not what can be called pure. We should remember that within ten generations every specimen may have 2,046 ancestors, that each bird is but a bundle of influences handed down to it, and that latent qualities and characters may cause reversion to an ancestral type unknown, and therefore unsuspected. As Professor Eugene Davenport says: "The differences that do exist within the same family serve to show the wide divergencies possible with the same hereditary elements, although, in studying adults, some allowance must be made for differences in development due to external causes." There is a further point which demands attention—namely, that families become exhausted much sooner than do breeds, due to the fact that the former are usually selected much more closely than are the latter, in which case the reserves for maintenance of virility are smaller. As the selection for definite external characteristics are often antagonistic to productiveness, so the extreme or hasty development of the economic qualities leads to degeneracy by the tax upon the system; these are abnormal, and have to be paid for in one way or the other. It will thus be seen that, whilst strain has a place, it is only one factor among many, and if unduly exalted may be harmful rather than helpful.

To summarize the question here dealt with, whilst absolute conclusions cannot be set forth, there is enough evidence to show that strain has been unduly exalted, and has no claim for the first position. In my judgment, economic development, either of eggs or flesh, is first determined by breed, with the capacity for increase in either direction, plus strain as a result of careful selection, plus environment, plus change of conditions from time to time, plus food, plus early breeding, plus proper management, and plus a score of influences of which little or nothing is known.

Structure of Body.—The experience of all breeders is that it is impossible to breed without variation. That is true in regard to external characters, and equally so with economic qualities; were it not so, breeding would be as easy as it is now difficult. What are commonly called "sports"—that is, exceptional and unexpected departures from the normal—are usually mutations without power of transmission of their special qualities to future generations, though that is not always the case, because many varieties of breeds have originated in this manner and are sometimes permanent. Abnormal laying may also be so classed. If variations were easily transmitted from one generation to another, we should lose the measure of fixity we now possess, and there would be no certainty in breeding. At the same time, improvement must be through the individuals, or, as stated by Professor Eugene Davenport,* "the excellence of breeding is mainly shown in the capacity for development," which may include every part and every function of the body. Capacity and fulfilment, however, are not the same; that all poultry possess greater capacity than is developed is evident.

It is desirable to inquire how far it may be possible to form a judgment as to economic qualities by the shape and structure and general conformation of each individual, presuming that these are in accordance with the general type of the breed or race. It is undoubtedly true that we cannot expect a merely mechanical grading, working with the exactitude of a barometer; but it is within general experience that functional development is in correlation with general appearances. The signs which mark meat breeds of cattle from dairy stock are evident, though in the latter there are great variations so far as milk yield is concerned; that, however, is due to development of the capacity already present.

We are justified in expecting that, as a general guide in selection, there are indications of service to the breeder, though these may not be absolute. The most we can expect is that in this

* "Principles of Breeding," p. 655.

way the latent capacity can be discerned. Development of that capacity will depend upon other influences.

If the structure of fowls is considered, we are at once met with a fact that the best quality of flesh is found on the breast. The object of all who seek to breed first-class table fowls is an abundance of breast meat, with as little as possible elsewhere; this is secured by expanding the muscles covering the sternum, and, as a consequence, development is almost entirely in that direction. Invariably is this associated with large wings, for the flesh on either side of the sternum forms the motor muscles of the flights. On the other hand, in developing the laying powers of a hen, there is enlargement of the egg organs, for one of the best-known facts in connection with every form of life is that use increases, and disuse diminishes, size; or, as Darwin puts it: "Increased use or action strengthens muscles, glands, sense organs, etc.; and disuse, on the other hand, weakens them. . . . The flow of blood is greatly increased towards any part which is performing work, and sinks again when the part is at rest. Consequently, if the work is frequent the vessels increase in size, and the part is better nourished."* As the egg organs of a fowl must necessarily lie in the posterior part of the body, if these are specially developed it will be found that the entire part is large as compared with breeds or families bred for table or breast properties. It should here be pointed out that the posterior part of a hen is greater than that of a cock, for the simple reason that she has to provide for egg organs, and he has not. At the same time the structure of the male of a highly fecund or a full-fleshed breed or family conforms to the type of the race ; and a further point is to be noted—namely, that in heavy laying birds the legs are set well apart to give play to the egg organs.

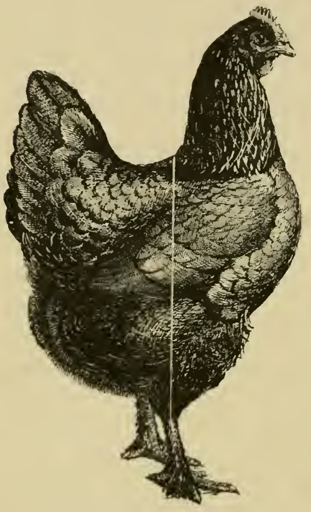


Fig. 2.—Type of General Purpose Fowl.

* "Animals and Plants under Domestication," vol. ii., p. 285.

Lining a Fowl.—In "Races of Domestic Poultry" will be found other considerations in this direction. In practice, therefore, to test the respective qualities of any fowl, a median line should be drawn right through the centre of the body to the legs. If a greater bulk of the body lies in front of this imaginary line (Fig. 3), the fowl may be classed among table varieties, and its position therein will be determined by the extent of its development, though, of course, quality and flavour of flesh are also to be taken into consideration. On the other hand, if the greater bulk of its body lies behind this median line (Fig. 4), that will indicate capacity for laying, such also being determined by the degree. There are, however, several races of poultry whose outline is represented by the letter Y, or by the letter U upon legs (Fig. 2), in that they are almost equally balanced upon both sides of this imaginary line; such we place in the general purpose class—that is, they do not excel either as layers or table fowls, and according to their development upon either side will be their merits in the directions named. I have carefully observed large numbers of fowls since adopting this method of testing the qualities of poultry, and have found it most reliable—nay, the

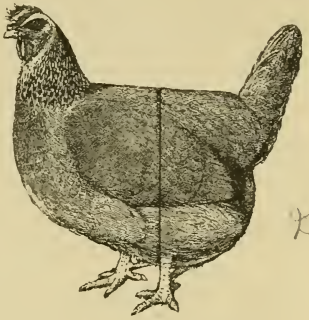


Fig. 3.—Type of Table Fowl.

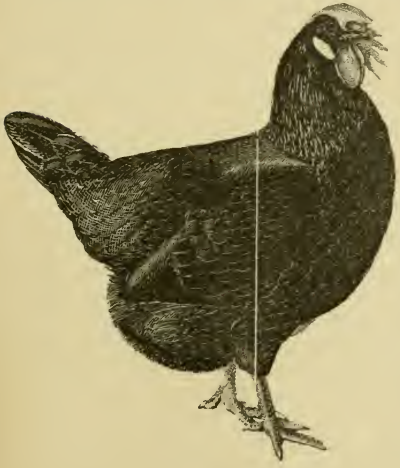


Fig. 4.—Type of Laying Fowl.

only true way of determining what is a most important point, keeping in view what has already been stated: namely, that it will not indicate actual production either of eggs or flesh. It should ever be remembered that excess in one direction is always at the expense of the other quality; there is no breed or individual which is at the same time a prolific layer and a high-class table fowl.

Size of Body in Relation to Production.—It has frequently been observed that the tendency in Britain is always towards increase of size of body. That, in my view, is partly climatic and partly due to abundant feeding, but not wholly so, otherwise we should be a race of giants. It is mainly, in the case of stock, a result of deliberate selection; this is seen in cattle as well as poultry. The idea commonly held is, the bigger the better. How far that has been carried out may be illustrated by Toulouse and Embden geese, by Bronze turkeys, by Dorking fowls, and, most recent example of all, the White Leghorn fowl. Big breeds are received with special favour, regardless of what is their leading quality. Much harm has been wrought in this direction. The effect of increase in size is a corresponding increase of inertia and often reduction of functional activity, as well as greater development of bone, which means more cost for food during the growing stage. Even in table poultry (although with these ultimate size must be considered, as " per pound " is often the standard) the biggest are not the best—that is, biggest in frame. What is wanted most of all is the capacity for flesh development when we arrive at the finishing stage—that is, fattening. Big-boned birds are coarse in flesh; further, the weight of meat in relation to the bone and offal is what determines the real value, not the total weight.

When we come to regard egg production, experience shows that, as a general rule, permanently and continuously, the smaller birds are the better layers, and that with increase of size of body above the racial mean there is a reduction of fecundity. For a year or two, by careful selection and better treatment, even hens of the heavier breeds may yield high averages, but the breeds which have maintained for a long period the front rank for number of eggs are small or small medium in size of body. That is equally true in respect to individuals within a breed; many evidences have been given of actual experiences in this direction. It is almost always the case that the best layers are small, compact, and carry no surplus bone or flesh. One of the most striking evidences of this was published by Mr. G. A. Palmer* in relation to weights of pullets entered for the Utility

* *Illustrated Poultry Record*, June, 1911, p. 408.

Poultry Club's Laying Competition, as compared with their position in the contest. These are given in a slightly different form:

	Total Weights of Group.			
	Leading 4 Pullets.		Last 4 Pullets.	
	lb.	oz.	lb.	oz.
Black Leghorns	11	4	17	14
White Leghorns	11	6	14	14
Buff Orpingtons	18	4	18	4
White Orpingtons	19	3	22	0
White Wyandottes	16	2	23	1
Buff Plymouth Rocks	17	4	17	8
Rhode Island Reds	18	10	19	6

It will be seen, therefore, that in every case except Buff Orpingtons, which were the same weights, the best layers were the smaller. The above figures refer to the commencement of the contest. Even more suggestive are the averages at end of the competition, as follows:

	Average Weights.			
	Leading Pullets.		Last Pullets.	
	lb.	oz.	lb.	oz.
Black Leghorns	3	8	5	13
White Leghorns	3	14	6	3
Buff Orpingtons	5	11	8	0
White Orpingtons	6	0	7	2½
White Wyandottes	5	6	6	12
Buff Plymouth Rocks	6	1	6	13½
Rhode Island Reds	5	8	5	14

To use Mr. Palmer's own words, " If we want size we may have it, but it must be at the expense of something else." That something is usually fecundity. Further, what is stated here is true in all other forms of domestic animals. Egg production is in inverse ratio to size of body—that is, relative to the mean of the race.

Size of Body in Relation to Size of Egg.—That the size of egg as produced by many breeds of fowls is abnormal may be accepted, due to better feeding and to selection. This question is dealt with from another aspect in Chapter XV. My immediate purpose is to show that the size of egg does not follow that of the body. With the exception of the Dorking, all the larger breeds and varieties of fowls lay comparatively small eggs in relation to the size of the hen. In contradistinction the largest eggs are produced by breeds which are small or small medium in weight, as, for instance, the Minorca, Andalusian, Braekel, and Leghorn. Some of the largest-bodied fowls, notably the Cochin and the Indian (Cornish) Game, produce small, though very rich, eggs. The turkey hen lays a comparatively small egg, very little larger than that from many hens, though the body-weight of the parent is two to three times that of the fowl. I do not suggest that the larger eggs contain nutriment to the extent of their increased weight, for such is not the case; as, however, size is a marketable factor, that must be considered. Careful selection may increase the size of egg, as it has done in many breeds, but appears to be more easily accomplished with small than large-bodied races, as, indeed, is attainment of greater fecundity.

Causes of Degeneracy.—That there is a constant tendency to degeneracy as a result of domestication, and especially of modern methods of breeding, cannot be questioned. How far this is due to curtailment of the migratory instinct of birds, and to keeping upon the same soil generation after generation, it is impossible to suggest. That both have their influence may be accepted. We know that crops require change of soil; upon the best potato or corn lands change of seed is important to secure a heavy yield, in spite of whatever manure may be applied. This is a subject demanding careful investigation, and is discussed in the next chapter. Food also must have a powerful influence. When birds are at full liberty and have to find the greater part of their nutrition, they are compelled to take a large amount of exercise, which in turn promotes digestion. If they are restricted in their range, provided with food which is not equally good as is Nature's diet, and for which they have to expend little in the shape of physical effort, there is a weakening of the muscles and organs, as of the skeleton, which in process of time will lead to enfeeblement. Further influences, in addition to those named below, are breeding from immature stock, artificial hatching and rearing, forced laying and growth, and bad conditions generally. I am not suggesting that these may not be counteracted, but that will only be by recognition of these influences and constant efforts to prevent them. It is not what takes place in one or two years, but the accumulation of influences, we have to guard against. To be forewarned should be forearmed. The importance of this question cannot be too strongly emphasized, as weakened parents mean chickens low in vigour.

Line Breeding.—The meaning of this term is that the birds chosen for reproductive purposes shall be restricted to individual members within the same line of descent. As a consequence there is a measure of relationship, though that may be more or less remote; it is, however, present. Such is distinct from inbreeding, considered below, for in that case the relatives are close in blood. That line breeding, in the hands of a careful breeder, makes for improvement of external characteristics, as, in fact, does inbreeding under more limited conditions, is undeniable. Many of our best races of poultry, as of other stock, have attained their present stage of perfection in this way. As an example may be cited the White Leghorn in Denmark. Imported first about 1880, even though subsequent introductions have taken place, it is evident that the stocks are mainly of the same line of descent; that is also true of the Pekin duck in Britain. What, however, has to be taken into account is the distribution over a considerable area, and the keeping and rearing under different sets of conditions, the effect of which appears to be considerable. What is here meant is that, supposing chickens from the same parent stock are scattered widely, there would be much less danger resultant from mating together birds in, say, the fourth and subsequent generations, than if these had been continuously bred on the same place; in this way the fourth stock of breeders would be third cousins. Such a system, properly carried out, and all the time with rigid selection for constitutional vigour, is a safe one for the breeder who is able or finds it worth his while to give the necessary time and attention to the work. For egg and flesh production, my own opinion is that it is not of the same value as for racial points. Professor Eugene Davenport shows clearly the disadvantages of line breeding as follows:* "The chief danger in line breeding is that the breeder will select by pedigree, abandoning real individual selection. A line-bred pedigree is valuable or dangerous in exact proportion as the individuals have been bred up to grade. . . . The only requirement is not to abandon individual selection. A pedigree is not a crutch on which incompetence can lean, it is guaranty of blood lines."

Inbreeding.—There is a strong tendency at the present time on the part of scientists and experimenters to urge the adoption of close breeding, largely due to the necessity for this system in working on Mendelian lines. That inbreeding has had a powerful influence in perfecting breeds and families is true. What we have to remember is, that the impulse given relates to the bad as well as the good characters; therefore, if powerful in one direc-

* "Principles of Breeding," p. 611.

tion, it is equally so in the other. Where the main object is production of eggs and of flesh, the question is entirely different, for these depend more upon natural vigour, plus capacity, than anything else; whatever weakens these is fatal to success. So far as I am aware, there is no really inbred family which has for long maintained its productiveness without outcrossing, or even the introduction of alien blood. I do not propose to discuss this matter at length, for whilst, in the hands of skilled breeders, more especially those who are able to operate upon a large scale and to make selection from a considerable number, inbreeding may from time to time be adopted, the risks of loss of vigour and fertility are so considerable that the ordinary farmer or poultry breeder is well advised to avoid such method; already there is far too much of it, with degeneracy as a result. Even though there might be apparently no immediate evidences of loss, it must again be pointed out that the ultimate issue will be unsatisfactory. Inbreeding tends to enfeeblement and loss of resistant power, so that the birds are unable to combat attacks of disease germs to the same extent as when more naturally bred, and are more amenable to malign influences. The degree of domestication—that is, in respect to the methods and conditions—will determine rapidity of influence. What may be of limited effect when fowls are on range, and the great law of survival of the fittest has full play, is completely changed when selection for mating is artificial, and conservation of the least fit is practised. Epidemics, however, and also general mortality, are but the expression of inability to withstand attacks of enemies, in which case those that succumb are the weaker birds.

Constitutional Vigour.—The forces which are at work militating against the maintenance of physical vigour and functional activity, though the latter is sometimes temporarily present to a degree when the former is absent, are so many and varied that the questions involved are of supreme importance to every poultry-breeder, whatever may be the scope of his operations. It is not too much to state that in this direction there has been a distinct retrogression within recent years, not only in the United Kingdom, but elsewhere. I am firmly of opinion that the increases of loss by death in shell during the embryonic period may to a large extent be explained in this way; that the huge mortality of chickens in our own land, as in America and Belgium, has arisen in part from the same cause; and that what is known as "blackhead" in turkeys, which has so smitten this section of the industry in the eastern areas of the United States, though enhanced by other influences, has been aggravated by loss of constitutional vigour in the parent stock. A further result is the immediate loss which takes place in other directions, notably fecundity of hens, and fertility in eggs, and flesh development, though the latter is least evident. Some suggestive observations have been made at Cornell University bearing upon this point.* These experiments were conducted over a period of two years, the results of which are very striking. Flocks of White Leghorns and Plymouth Rocks proved so unequal in growth that they were divided into strong and weak, respecting which observations were carefully tabulated. It was found (1) that in all cases the weaker birds consumed more food per dozen eggs produced than the stronger, probably due to the latter proving better foragers; (2) that the number and value of eggs produced and the profits made were greater from the strong flocks than the weak; (3) that the mortality in adult birds was, in the main, greater in the weak than in the strong; and (4) that the percentage fertility of eggs, of chickens hatched, weight of chickens when hatched, and of chicks living at the end of six weeks, were in favour of the stronger birds. Such data are confirmed by practical experience, though not hitherto tabulated so completely.

As to the external evidences of constitutional vigour, I quote from a bulletin published by the Maine Agricultural Experiment Station, U.S.A., in which it is stated:

"The bird of high constitutional vigour will have a thrifty appearance, with a bright eye and clean, well-kept plumage. The head will be broad and relatively short, giving in its appearance plain indications of strength. It will show nothing of the long-drawn-out, sickly, crow-like appearance of the head which is all too common among the inhabitants of the average poultry-yard. The beak will be relatively short and strong, thus correlating with the general conformation of the head. Comb and wattles will be bright in colour and present a full-blooded, healthy, vigorous appearance.

"The body of the bird of high constitutional vigour will be broad and deep and well meated, with a frame well knit together, strong in the bone, but not coarse. In fowls of strong constitution and great vigour all the secondary sexual differences will usually be well marked; in other words, the males will be masculine to a degree in appearance and behaviour, and the females correspondingly feminine. It must be noted, however, that this last is a general rule to which there are occasional exceptions."†

To what is here stated may be added activity of habit, alert-

* "Constitutional Vigour in Poultry," by C. A. Rogers, Bulletin 318, 1912.
† "The Biology of Poultry-Keeping," by Dr. Raymond Pearl, 1913.

ness of vision, and capacity for foraging, with pronounced ability in respect to self-defence. It may, however, be pointed out that, in the table breeds of poultry of the higher grades, the constitutional vigour is not so great under all conditions as with the egg-producing and general purpose races.

Simplicity in Selection.—In "Races of Domestic Poultry" an attempt is made to discern how far external characters are indicative of and related to economic qualities. It is admitted that reliable knowledge upon this question is limited in the extreme. My present purpose is to show that the multiplication of arbitrary characters, and breeding for their development, are antagonistic to the rules of practical breeding and productiveness; it is here where the great cleavage between the fancier exhibitor and the business poultryman arises. The standards adopted by the former increase and magnify minor points, which to a very large degree determine success in exhibitions; as a result, economic qualities are sacrificed. Elaboration in this direction tends to greater variation. It is for that reason in Germany and Holland distinct standards of points for utility poultry have been adopted from those promulgated by breeders for exhibition, as the latter are found to be in reverse ratio to the productive qualities, and frequently opposed to natural vigour. What we have to aim for is simplification rather than complexity, to reduce the number of selective characters rather than their increase, which latter explains why highly-bred stock are often the least profitable. "The breeds in which many requirements have been exacted contemporaneously have had a chequered history, full of ups and downs, and the end is not yet—nor will the end be in sight until the custom is abandoned of requiring at the same time so many points as to put the matter beyond the range of practical selection."* There are many examples among the respective breeds of poultry proving the truth of what is here stated. Exaltation of existing and introduction of new arbitrary points have ruined several breeds, and are destroying the productive qualities of others. The practical breeder of poultry should first of all make selection in respect to constitutional vigour; the second consideration is suitability in accordance with the product, whether eggs or flesh, he desires to secure; third, suitability of the birds to environmental conditions; and, lastly, type and external character, taking care that the latter are not antagonistic to what is stated before. In this way racial distinctions can be maintained without sacrifice of more important factors.

* "Principles of Breeding," by Professor Eugene Davenport, p. 657.

Parental Influence.—In polygamous races the influence of the male parent must always be much greater than that of any individual female, so far as the flock is concerned. For example, if a cock bird be mated with ten hens, and from each of the latter a score of chicks are produced, every female will have a half-share, it may be—though upon this point opinions vary—in twenty and no more, whereas the male bears responsibility for half of all the two hundred youngsters. That being so, whilst it is important that every hen shall be rightly selected and have the capacity for producing chickens embodying the desired qualities, it is of tenfold greater import that the male with which she mates shall possess the same influence, together with power of transmission. One bad hen in a flock will involve loss to the extent of what she does or does not do. If her mate be inferior or incapable, the damage wrought will affect all; therefore, selection of the male demands the greater care and repays the greater trouble. In my younger days it was a common idea that the male was everything, and so long as he was right the quality of hens did not matter. To some extent the same notion still prevails among ordinary farmers, who buy pure-bred males annually and mate with such hens as they have. Then came a reaction. Selection of hens, more especially on the introduction of trap-nesting, swung the pendulum to the opposite extreme. We seem now to be on the verge of reversing once more. This question is further discussed in Chapter XXI., so far as it applies to egg production.

Leaving out all questions of physical defects, there are certain general guiding principles that may be accepted. These are—

The male primarily influences the external characters—namely, build, type, plumage, and action.

The female primarily influences size of body, colour of skin and legs, constitution, temperament, and habits.

In saying thus much it must not be thought that the opposite sex has no share, for such is not the case. Instances are by no means unknown when what is stated above seems to be entirely reversed.

Mendelism.—The study of genetics during the last few years has received a large amount of attention, and is resulting in a great accession of knowledge, which should ultimately be of vast importance to the breeder. To a large extent observations made are on what are known as Mendelian lines—that is, following the discoveries made some years ago by an Austrian monk named Gregor Mendel, which for a considerable period were disregarded, as is frequently the fate of pioneers. I do not propose to enter into a detailed description of this theory, for that should be studied at first hand in the works of its chief exponents in this and other countries, such as the little book "Mendelism," by Professor R. C. Punnett,* or in Professor W. Bateson's larger and more complete work entitled "Mendel's Principles of Heredity."† The practical application of this theory, however, in so far as eggs and flesh production are concerned has yet to be demonstrated. In this direction Dr. Raymond Pearl is engaged in researches as to fecundity at the Maine Agricultural Experiment Station, U.S.A. It is too early to say whether Mendelism is likely to help in this direction. Briefly stated, the theory is, to quote the words of Professor Bateson,‡ that "the bird can be no longer looked upon as one individual whole, but it must be regarded as an aggregate of diverse factors. . . . Since the different characteristics depend for their development on the presence of different factors, the purity of a bird is not a collective quantity, but one which must be separately considered in respect to each of the several factors on which the characteristics of the breed depend." That much, so far as externals are concerned, is a great accession of knowledge, and can hardly fail to be of great value to breeders of pure stock, both for the perfecting of existing and the evolution of new races. The suggestion is made that the factors referred to exist in the female ovule and the male element which fertilizes it, otherwise they could not appear in regular sequence in the chickens. How far what are known as the productive qualities—that is, the capacity for eggs and flesh—arise in this way, and whether such can be increased, have yet to be determined; also the extent to which environmental influences and food contribute to these results. A further point is that certain characters exert themselves more or less powerfully, to which the terms "dominant" and "recessive" are applied. These are explained by Professor Bateson in the same article as follows: "When the character is due simply to the absence of any modifying factor there can be no mistake. . . . Such characters are called 'recessive.' Characters which are due to the presence of some factor are called 'dominants,' in contradistinction to these recessives." For example, white skin is said to be dominant to yellow, and the fifth toe also; so that when two birds are mated, one a possessor and the other not of either quality, the great majority of the progeny will follow the former. We have yet to learn how far this theory applies in what may be termed the practical qualities; further, no account is taken

* London, Macmillan and Co., 1905.
† Cambridge, The University Press, 1909.
‡ *Illustrated Poultry Record*, June, 1910, p. 466.

of the tendency to variation in any and all directions. Where danger lies is that for application of the Mendelian theories the progeny must be closely interbred—in fact, between brothers and sisters of succeeding generations—the ill effects of which may be minimized to some extent by skilled breeders, but cannot be altogether obviated. Probably we have here an explanation why biologists discount the objections raised against close in-breeding, for without that Mendelism is non-existent, so far as application to breeding stock is concerned.

Age of Breeding Stock.—A very common, but none the less fallacious, idea, at least in connection with poultry, is that when the power of reproduction commences that is the right period to mate up the stock birds. Such is not suggested for cockerels as for pullets to the same extent. Puberty in animals long antedates maturity. It is not contended, however, among the higher orders that mating should immediately take place subsequent to attainment of that stage of development. The process in the case of domesticated fowls is the same, although the form differs, as the embryonic stage is subsequent to production of the egg, so that the latter must contain the elements for formation of the embryo. As a consequence, by the use of eggs produced from young pullets, and even to a greater extent if these are mated with young cockerels, the chances are great that the germs will not have attained the maximum of vigour, and that the egg contents are not at the full measure of nutritive elements. Fortunately, there is no waste as in mammals, for the avian egg is valuable as human food. Whilst, therefore, from that point of view, early productiveness should be encouraged—for it is apparent that unless laying commences a considerable time before maturity is attained the fecundity will be less than would otherwise be the case—the eggs should not be used for hatching, unless for the production of birds to be killed at an early age. It is undoubtedly true that the reproductive functions are most active immediately prior to maturity, and it is equally evident that birds bred thus and then have not the same virility of constitution as will be the case when the parents are older. Sexual activity is not always accompanied by constitutional vigour; in fact, the reverse is often true. Further, it may be noted that the better way to transmit laying capacity, as proved by early laying and high fecundity, is not to use such birds as breeders during the first period, but later, when they have attained full maturity. In proof of what is here stated, I am not acquainted with any records relating to fowls, but in a paper submitted to the Eugenics Congress of London, 1912, by Dr. Corrado Gini, of the Royal

University, Cagliari, Italy,* he shows that when mothers are under twenty the weight of infants is from 8 to 12 per cent. less than when they are above that age, and that the mortality of infants at the Hague in 1908 from mothers under nineteen years was from 24 to 27 per cent. greater than when they were twenty years old and upwards. This may in some measure explain the heavy chicken mortality of which many breeders have complained.

Such observations, together with practical experience, show that, with the exception stated above—namely, to secure early eggs for the production of chickens and ducklings for killing, which can do no harm—two or three year old cocks and hens should be used as breeders of stock birds or as layers. In the case of turkeys, I am certain that much of the delicacy which characterizes that species of domestic poultry has its origin in hatching from eggs laid and vitalized by yearlings. I could come to no other conclusion than that the serious epidemic among chickens which devastated Belgium in 1912 and 1913, when hundreds of thousands died either during the embryonic period or when from two days to three weeks old, was in part due to the loss of resistant power as a result of continued breeding from immature parents. On the other hand, whilst three years for hens and even less for cocks may be the practical limit of age for breeding stock, if a hen especially has proved to be a mother of a high average of chickens, I should retain her even longer.

Selecting the Breeders.—It should ever be remembered that only a percentage of any flock are fitted for the all-important work of reproduction. What that percentage is no one can say, as it varies considerably. In some cases it may be 30 or 40 per cent. of the birds bred; in others only ten out of each hundred. A safe measure for general purposes will be to say that 20 per cent. and no more should be so used. In this way, and by careful selection, can we hope to maintain or improve the quality. Yet one of the chief mistakes which is made by farmers especially is breeding from the entire flock. Many there are who will introduce new males every season, and take eggs for hatching from any or all of the hens, so that there is no selection whatever, and frequently eggs from the worst are used, as these happen to be available when a hen has become broody. The plan which should always be adopted is to carefully select the breeders, mating them with a male for every lot of ten to twenty hens in accordance with the breed. Each flock should be placed in a separate house, to which a run may be attached if necessary, though that is not requisite on a farm. In this way breeding operations are

* "Problems in Eugenics," vol. ii., London, 1913.

controlled as far as that is possible; those not so mated will form the layers of eating eggs. Breeding from the best is the only true method.

Functional Variations.—As no two blades of grass, and certainly no two fowls, are exactly alike, so the relative productiveness or development of birds varies considerably. I have been impressed when trap-nesting hens hatched together from the same parents, and kept under identical conditions, or weighing chickens during the growing stage, how small a percentage lay the same number of eggs or attain exactly the same degree of growth during equal periods; in many cases the recorded results are wide in the extreme. Professor Davenport points out that "probably no fact in animal physiology is of more far-reaching importance than is this marked instance of functional difference between individuals." He further states that "functional variations may be accumulated into true breed distinctions, and that strains of animals and plants may be permanently established with exceedingly high efficiency in desired lines; indeed, this has been already accomplished, though we are still far short of what is possible." The former is one of the limitations, as the latter is the hope of the practical breeder. What, however, has always to be kept in view is that an undue strain upon all vital functions tends to their partial or entire breaking down sooner or later.

CHAPTER V

ANATOMY OF THE FOWL

There are five special characteristics which distinguish the skeleton of birds from that of mammals (Fig. 5): (1) The greater lightness of bone, many of the bones containing large air cavities, in order that the bird may be able to rise in the atmosphere, not only by reason of the reduced weight to carry, but also that the air cavities aid in the flight. (2) The marked tendency of bones, at first distinct, to fuse with one another in the adult. This is present to a certain degree in all animals, but to a lesser extent in mammals than in birds. If we compare the head-bones of a chicken with those of a fully-developed fowl, we find a marked proof of this fusion. (3) Modifications in the limb-girdles and limbs, fitting the bird both for walking and for flight. (4) Great length of vertebral column, with elongation and flexibility of neck, the neck being equal in length to rest of the column. (5) The rigidity of the body proper, which in itself has practically no movements.

Skeleton.—The body itself differs from that of mammals, as it is broad in front and narrow behind. The backbone is flat, and, together with the vertebræ of the neck, contains the spinal column, but at the posterior end is a continuation known as the pelvic girdle, which consists of three bones, and the whole is spoon-shaped on its inner side, widening out at the back. Below the ilium, next to the body proper, is a depression in which the kidneys lie. The caudal vertebræ has a terminal, called the pygostyle, holding the sickle feathers of the tail. From the backbone spring the ribs, of which there are seven on each side. Two of these, the cervical ribs, are short, and not attached to the breastbone, or sternum ; the other five, known as the thoracic ribs, turn backwards at first, and then reverse, joining the sternum, the vertebral portions being thicker than the sternal.

Sternum.—The sternum, or breastbone, is very large, and projects back far beyond the ribs, and over the greater part of the wall of the abdomen. This is a spoon-shaped blade of bone, wide and stout in front, narrowing in the middle portion of its length, but widens somewhat behind, forming a protection to the chief organs, which lie in the cavity between it, the backbone and ribs. The keel is a prominent narrow blade attached to its outer side, slightly thickened in front, its depth depending upon the size of the wings. The object is to accommodate the muscles which work the wings. In some breeds it is greatly abbreviated, due to small wings, and where this is the case the quantity of muscle, or flesh, carried on the breast is relatively small.

Scapula and Furcula.—Connecting the sternum with the shoulder is a stout straight bone, the point of connection being termed the scapula, known as the coracoid, near which are two clavicles, a pair of slender curved bones, whose upper ends are slightly expanded, forming the furcula, or merry-thought. This furcula is a spring used in working the wings, and it varies in accordance with their size.

Wings.—The wings of a bird correspond to the fore-limbs of animals, but are carried upon the body. When folded in a position of rest, the three parts are bent on each other like the letter Z, the elbow pointing backwards and the arm upwards. The humerus, or bone of the arm, is single, slightly curved, and expanded at both ends; the forearm has two bones: the radius, slender and nearly straight, and the ulna, much stouter and slightly curved, the two joining at either end; the wrist connects with the manus, or hand, in which can be distinguished a thumb and two fingers, more or less rudimental. This mechanism, together with the feathers, is the basis of an instrument of locomotion. On the posterior border of the hand, forearm, and arm are the wing feathers, the length of which diminishes nearer the body.

Legs and Feet.—The hind-limb, or leg, is formed for walking and perching. It is long, and composed of a femur, or thigh-bone, a cylindrical, slightly curved shaft with enlarged ends; of a tibia, or leg-bone, large, stout, and nearly straight, though in some breeds it is much heavier than in others; of a stout, straight bone, known as the tarso-metarsus; of an ankle-joint; and of four or five digits, or toes, attached to the foot. Four toes is the regular number, but several breeds have five. These toes are—the hallux, or great toe, behind, and the second, third, and fourth toes in front, the third being largest. Each is fitted with a claw. A fowl walks on its toes, not feet, and they have great power in gripping. The spur of the cock is a small, irregular nodule of bone, varying in size, and intended for defence. The thigh is covered with muscle and sinew, differing in quantity, according as a fowl chiefly uses its pedal limbs or wings.

Head.—A fowl's head is small in relation to other parts of its body, with which it is connected by a long, thin column of vertebræ. The characteristics of a bird's skull are—(1) Its great lightness; (2) the marked tendency of the bones of the cranium to fuse together, most of the cranial sutures being closed and the two outlines of the bones obliterated by the end of the first year; (3) the large size of the orbits, or eye spaces, these being separated by a thin vertical plate; (4) the prolongation of the face forwards into a conical toothless beak. The head is composed of two parts: a cranium and a face. The cranial portion is a somewhat conical box of bone, the base of the cone forming the hinder part of the skull, and the apex being directed forwards. In the aperture thus formed are placed the brain and eyes. The beak is divided into a superior, or upper, and an inferior, or under, mandible. The jaw, or superior mandible, has, owing to a peculiar union with the cranium, a mobility which is not seen in mammalian animals. The two nostrils are small, and the olfactory capsules remain cartilaginous throughout life. The nasal cavities are separated by a thin piece of bone, and open into the interior of the mouth by a simple slit, long, narrow, and longitudinal, and furnished with small indentations. This slit opens when the bird's head is turned downwards, or in its natural position, and shuts when raised. It is for this reason that fowls when they drink are obliged to raise the head, otherwise the water would run out of the nostrils. The lower mandible is slightly shorter than the upper. Fowls have no teeth in either the upper or lower mandible. The brain is situate in the back part of the skull.

Digestive Organs.—Dr. Lardner thus describes the digestive organs of birds:* " The œsophagus at the lower part of the neck enters the first stomach, called the crop, which is an enlarged pouch enclosed by membranous walls, the form and magnitude of which differ in different species.

Crop.—The crop is most developed in granivorous birds, less so in birds of prey, and is altogether absent in the ostrich and most piscivorous birds. Immediately below the crop there is a contraction of the canal, followed by the dilatation called the *ventriculus succenturiatus.*

* " Handbook of Animal Physics," p. 483. London: Lockwood and Co.

Gizzard.—Although this enlargement is not considerable, it plays an important part in the phenomena of digestion, its sides

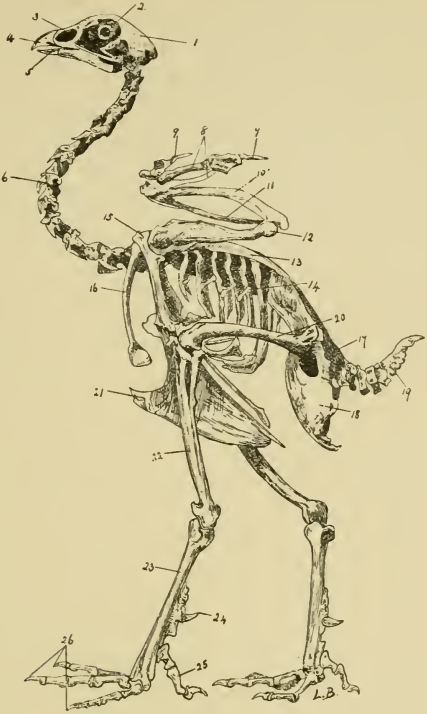


FIG. 5.—SKELETON OF THE FOWL.

1. Skull.
2. Eye cavity.
3. Nasal cavity.
4. Upper mandible.
5. Lower mandible.
6. Vertebræ of the neck.
7. Digit.
8. Bones of hand.
9. Digit.
10. Ulna.
11. Radius.
12. Humerus.
13. Backbone.
14. Ribs.
15. Scapula.
16. Clavicles (merry-thought).
17. Acetabulum.
18. Ischium.
19. Pygostyle.
20. Femur bone.
21. Sternum or breast-bone.
22. Tibia.
23. Tarso-metarsus.
24. Spur.
25. Back toe.
26. Toes.

being covered with glandulous follicles, which secrete a juice analogous to the gastric juice. This ventricle is larger in birds which are destitute of the crop than in those which have that organ.

This second stomach is succeeded by a third, the gizzard, in which the chymification of the food is completed. This part of the digestive apparatus is furnished with a muscular tunic, which has great thickness and power in granivorous birds. In the ostrich its strength is so great that the hardest substances are crushed by it. It seems to be endowed with the functions of an apparatus of mastication. The intestine which follows this consists, as in mammifers, of a small and large tube of different lengths, the former being much the longer and coiled up in folds, as in mammifers. At the point where the small enters the large intestine, two tubes, called cæcums, enter it, which are closed at the upper ends. These are generally long and large in granivorous and omnivorous birds, but little more than rudimentary in birds of prey.

Intestines.—The thorax and the abdomen are not, as in mammifers, separated by a diaphragm muscle; and the liver, which is very voluminous, fills the chief part of both cavities. It is divided into two lobes, nearly equal in size, from which issue two ducts, which, after uniting, open into the intestine. There is generally a gall-bladder, which receives a portion of the bile, pouring it into the intestine by a separate canal.

The pancreas is lodged in the first fold of the small intestine, and is generally long, narrow, and more or less divided.

The spleen is small, and its uses are as little known as in the case of mammifers. The kidneys, on the contrary, are very voluminous, irregular in form, and lodged behind the peritoneum in several cavities formed along the superior part of the pelvis. They do not, as in mammifers, possess a distinct cortical substance. In that part of the great intestine which corresponds to the rectum, there is an enlargement called the cloaca, into which the liquid secreted by the kidneys is discharged, and mixed with excrements expelled from the intestines.

The nutritive products of digestion, as in mammifers, pass from the intestines into a system of lymphatic vessels connected with it, which converge into two thoracic ducts, which discharge their contents into the jugular veins at each side of the neck.

Vascular System.—The vascular system of fowls consists of a heart with four chambers, from which the blood is distributed by means of arteries. The blood is about 2° warmer than that of mammals, due to the fact that the body heat is retained by the feathers, which are bad conductors.

Respiratory Organs.—Respiration is secured by lungs, which are fixed to the back of the fowl, and maintained below by a resisting membrane, which, in order to secure the inhalation and exhalation of air, is moved by muscular power. The lungs are pierced with holes, and thus the air is able to circulate all over the body, even to the bone cavities. The trachea, or windpipe, is long, which, together with the bronchi, has cartilaginous rings. The lungs themselves are surrounded by air-sacs, forming reservoirs, and there are others, nine in all, in the breast and lower part of the abdomen. These give a lightness to the body, and enable birds to rise easily from the ground.

Ovaries.—In the hen are two ovaries, but it is found that only one is active at the same time. In appearance the ovary is not dissimilar to a bunch of grapes, the ova varying in size from small specks to full-sized yolks, when the bird is productive. Further information as to the number of oöcytes in the ovaries of hens will be found in Chapter XXI. As each ovum comes to its full maturity, the process of filling the yolk-sac having been in operation for some time, there is a rupture of the ligament by which it is attached to the ovary, and it falls into the open mouth of the oviduct, a tube about 2 feet in length, and during its passage down this tube it is first impregnated with the male element, and then coated with successive layers of albumen, with the two shell membranes, and finally with the shell, the whole process taking about eighteen hours. At first the germinal vesicle is situate in the centre of the ovum, but as it increases in size it rises towards the upper side. The male reproductive organs (testicles) are two in number, and are found in front of the kidneys.

Senses.—The brain of fowls is well developed, but the various senses vary very much from those of mammals. The skin is not sensitive, due to the fact that it is covered with feathers. These feathers are composed of a stem with a hollow base, and inserted in a bulb, and attached to the stems are barbs, covered with down, hardly visible, however, to the naked eye. Taste and smell are neither very keen, the tongue being the most sensitive in this respect; still, at the same time, fowls reject those things which are objectionable to them, but probably this is more due to sight and memory than from any other cause. The sight of poultry, as of all birds, is very piercing; they are also very acute in hearing.

CHAPTER VI

CLIMATE AND SOIL IN RELATION TO POULTRY HUSBANDRY

Natural Advantages.—A very common, but nevertheless erroneous, impression is prevalent that the reason why poultry and eggs are produced to such an enormous extent abroad is that the climatic influences are more favourable than in this country. Frequently we hear that reason given why poultry-keeping has not developed to the extent which might have been anticipated. It is desirable, therefore, to consider this question, because natural advantages or disadvantages must determine to a large degree the industry of any country.

What is the reason that the United Kingdom has been the centre of the world for the breeding of high-class stock of every kind ? We may fairly give credit to the skill of breeders, and to the somewhat cramped conditions under which they must work, compelling them to make more rigid selection than would be the case in a larger and more thinly-populated country. But the skill referred to must have some explanation, and we believe that it is the direct result of the favourable conditions under which breeders have worked. Whilst, therefore, giving full credit to stock-raisers of every class for the way in which they have perfected the different races and breeds of domestic animals, it would be foolish in the extreme to claim that this skill has not been assisted by their conditions. We may in this connection ask, Why is it that our animals, and also the human beings inhabiting moist, temperate zones, are fuller-bodied and more fleshy than is usually the case, at any rate in warmer climes ? Part of this is due to the food upon which they live, but not entirely, and it is a fact that anyone emigrating from this country and remaining, say, in America or South Africa for a few years will be distinctly different in appearance from what he was at first, and than he would have been had he stayed at home. This question offers a very wide field for inquiry, but I can only indicate some of the main points for consideration.

Climatic Influences.—It will be within the observation of everyone that the temperate zone has manifest advantages over countries where extremes are met with. We must recognize that large portions of Europe and of North America, as also of Australia and New Zealand, lie within the temperate zone; but these countries vary very considerably. Many people have a strange notion that the greater heat of the summer is advantageous, but that is not so. Those who have travelled on the Continent know that the intense heat burns up vegetation, and thus the supply of natural food is enormously reduced, whilst the evaporation of body moisture is met with to a greater extent, explaining why, under ordinary conditions, stock is much leaner during hot weather and in hot climates than in cooler weather and colder countries. Excessive heat is as disadvantageous as extreme cold, which explains why the temperate zones are most favourable for all kinds of livestock, whilst a moist climate, by keeping the herbage in a good state nearly all the year round, exercises a beneficial effect which has never yet been estimated at its full value. In this country it is very seldom indeed that there is no growth in the grass, and our fields as a rule keep green all the year round. Occasionally we have severe winters and hot summers, when natural foods, both animal and vegetable, are scarce; but these are the exception. Therefore, so far as we are concerned, every opportunity in respect to climate is given for the development of poultry husbandry. When we bear in mind what has been done in other countries, the greatest encouragement is afforded for the extension of our work.

Reference has already been made to the effect of heat upon the body—namely, causing evaporation of moisture, and therefore hardening the tissues. It is also true that cold, by inducing elimination of the heat force, has the tendency to reduce production and increase food consumption, whilst the food must be of a more oily nature. Where it is possible, as is generally the case with us here, to secure an equable climate, then all the conditions are present for the development of any kind of stock-raising. I firmly believe that the reason why Ireland produces such fine quality butter, and also why the United Kingdom is famous for the richness of the animal flesh produced upon its pastures, is due to the conditions already referred to. In this connection it is well to bear in mind that even within the confines of a small country like the United Kingdom places will be found which are more suited for breeding than for feeding, and *vice versa.* That fact should be kept in view. It is seen in connection with cattle and sheep. Our object should be, therefore, to study the conditions both of climate and of soil with a view to adopting methods which will conduce to the greatest amount of success.

Moisture in Atmosphere.—I have already indicated that moisture in the atmosphere has a very important influence upon stock-raising. By this I do not mean that the action is direct—though that is open to discussion—but that where a dry air prevails (and dryness may be the result of either extreme cold or heat) the quality of the grass or other growth is affected, and the influence is seen in the flesh and eggs obtained from the fowls kept thereon. It is well known that grass is richer in moist countries, unless the moisture be excessive; that it grows perhaps less rapidly but more constantly; and that it lasts much longer. Although the fowl originated in India, many birds have been taken from this country to improve the stock met with there, but they lose size very quickly. Moisture fills out the body, securing that increase of size and bulk which is characteristic of nearly all life in the temperate parts of the earth, and especially those surrounded by the sea. Moreover, moisture secures for the birds a much more abundant supply of natural food, which has a constant and long-sustained influence upon their growth. In eggs 74 per cent. of the total bulk consists of moisture. Thus, if a hen lays 120 eggs in the course of twelve months, each weighing 2 ounces, she produces a total bulk of 15 pounds, of which nearly 11¼ pounds consist of water. The greater part of this will be obtained either from the atmosphere directly, or indirectly through the food consumed. In flesh also there is 72 per cent. of moisture, and it can be understood that dryness, either due to excessive heat or cold, must tend to reduce the bulk of flesh. At the same time we must recognize that excess in moisture is equally injurious as is deficiency, for reasons which are explained below. A very wet, cold place will mean that the birds will be subjected not only to atmospheric cold, but also to earth cold, which will be injurious in the extreme. On the other hand, if we have a combination of very hot air with dry, hot ground, then the effect upon the animal life must be much greater than if only the air were hot. Our object should be to avoid extremes, and whilst we may have a great deal to say in condemnation of the moist conditions of the British Isles, on the whole there is no doubt in my judgment that it is beneficial, and conduces to that quality of stock of which we are so proud.

Variations of Climate.—Within the confines of one country a great variation of climate may be found, more especially in countries so diverse as the United Kingdom. Mr. Primrose McConnell, in his valuable work on "Agricultural Geology," points out that where the same conditions prevail in many cases, even though hundreds of miles apart, the stock has a uniform type. He says that "We find on the American continent, on the prairies, a region of land very similar to Eastern Europe, and this similarly tends to wipe out the differences between breeds. British breeds have a tendency there to lose their characteristics, and would in time, if allowed freedom, revert back to some common form when continuously bred under one set of geological surroundings."* My object in calling attention to this fact is to show that the varying climate and conditions found within the British Isles is a distinct advantage, in that it provides a variation which explains to some extent the different breeds met with in this country. Of course there are considerable variations in temperature and in climatic conditions. Some places are colder than others, to a large extent a question of altitude and of exposure; others are influenced by the Gulf Stream, and probably in no place in the world can the same diversification be met with. In the work just referred to, Mr. McConnell points out that "on the average, the month of January is warmer in the North of Scotland than it is in the Midlands, and the cold winters of some Northern and Midland districts are the result of their elevation and position, rather than any difference of latitude."† It is therefore most necessary that attention should be given to this question, because it at once indicates the importance of keeping in view the climatic conditions in making choice of the branch of poultry-keeping to be followed. In countries which are uniform we may find the same methods adopted over a very wide area, but that practice would be inadvisable under our own conditions.

Soil.—Here we approach a much more difficult branch of the subject, and one which has not been given the amount of study in relation to poultry-keeping it deserves. At the same time, it will be recognized that soil must have a great influence upon the animals and plants existing thereon, and it is realized to some extent, at any rate, that many of the variations met with in all animal and plant life are due to the influence of the soil. It has been suggested—but upon this point we have little information—that the coloration of our various animals and birds is to some extent due to the soil upon which they are kept. At this stage

* "Agricultural Geology," 1902, p. 298. † *Ibid.*, p. 108.

it would be impossible to express any definite opinion thereon, as our knowledge is too scanty. It has been claimed that eggs produced upon iron-stone yield richer yolks than elsewhere, and there appears to be justification for this statement. There can be no question that whether the plumage is affected by the soil to the extent which is sometimes imagined or not, the colour of the legs and flesh is primarily due to natural causes, and it is to the lighter soils we owe those white-fleshed birds which are preferred in this country for table purposes. There can be no question, however, that breeding largely increases any tendency in that direction, but by breeding I mean the fixing of any modifications that may have been introduced naturally. Mr. McConnell, speaking of the horse, says: " Within the last 1,000 or 1,500 years there has sprung up such a vast diversity of breeds within our islands as cannot be matched elsewhere on the surface of the earth on an equal area. That the complex geological structure of these islands is at the bottom of this divergence is the belief of the present writer."* This is equally true with respect to poultry, and we may accept the statement here put forth.

It is within the observation of many poultry-keepers that the tendency of light, dry soils is to bleach the legs and to have an influence upon the colour of the flesh, whilst, on the other hand, heavy soils deepen the colour of the legs. My attention to this question was stimulated some years ago by the experience of a then well-known poultry exhibitor. He was a breeder of Plymouth Rocks, and had lived for a considerable time upon the heavy flat lands of East Essex. His birds were famous for the brilliancy of the colour of their legs. He afterwards removed into Surrey, where the conditions are absolutely opposite, and the result was that the birds which in Essex had been brilliant in the yellow of the legs paled greatly, and it was only in so far as he was able to put them down upon moist, heavy land that he could retain the colour satisfactorily for the exhibition pen. This observation led me to watch the question very closely, and I therefore have come to the conclusion that in selecting the breed, and consequently the branch of poultry-keeping, the nature of the soil is a most important point for consideration. There is no effect without a cause, so the variations which are met with in our poultry are the results of differing conditions. Where breeding has been carried out for a sufficient length of time to entirely change the nature, then it is desirable that the class of fowl shall conform to the conditions under which it has been produced. It may be mentioned that it is not a question of the

* " Agricultural Geology," 1902, p. 266.

different parts of the country so much as the soil. Dorkings thrive excellently and attain early maturity and great size in Scotland, but only where the soil is favourable, and many of the best exhibition birds of that breed come from either North Britain or North Ireland. Keeping this fact in view, it will at once be evident that breeds should be maintained upon the soil most suited to them, and that under other conditions there is greater tendency to variation. Some years ago a proposal was made that there should be an international standard of points for poultry, which has been recently revived. This I strongly opposed, believing that it is an impossibility, and that the change from one country to another must cause differences in type, and which can only be minimized by, as far as possible, keeping fowls upon the soil to which they are most suited.

Effect of Soil on Growth.—It is within the observation of many poultry-keepers that there is a great difference in places as to the rapidity with which chickens can be raised. This is in some cases due to position. For instance, land facing south and having a slope of, say, 30°, would receive the greatest amount of heat; and a northern slope at the same angle would be found to be 3° F. colder than the former. The difference to be noted is not merely a question of aspect, but also of the nature of the soil. Whilst it is true that heat and cold are to a large extent atmospheric, yet there is a great difference in the temperature of the ground itself, this being a result of its nature and formation. Mr. McConnell says:* "The difference in temperature of soils due to mere wetness or dryness is considerable. Schübler found that the average of twelve soils gave a temperature of 100·5° F. in the wet state, as against 112·5° in a dry state, showing a difference of 12° F." Here we have an explanation as to why chickens are much slower in growth on heavy soils. As an instance of this, I was consulted some years ago by a farmer in one of the eastern counties as to his taking up the raising of chickens for market. On hearing that his farm was heavy clay land, I suggested that he had better go in for egg production, and pointed out that he would find that chickens could not be grown as rapidly as upon a lighter soil. However, he was determined to try, and after three years he gave it up by reason of the fact that, whilst he could fatten just as well as in Sussex, the birds never were as good. Moreover, they took from three to five weeks longer to grow to a fattening age. This observation has been followed by many others, and, therefore, in this respect also it is most important that the soil of the district shall be studied in

* "Agricultural Geology," 1902, p. 132.

order to determine the branch of poultry-keeping to be followed. Damp land is not suitable for fowls, though it may be good for ducks, provided precautions are taken that the birds shall have a dry sleeping-place. Heavy clay land is most suited for egg production, and it is upon the medium and light soils only that table poultry-raising should be attempted. Even upon the different soils it is desirable to study the breeds which conform to the local conditions, with a view to avoiding mistakes. We quote here from Mr. McConnell's work on "Agricultural Geology," a summary* showing that the temperature of the soil is influenced in the following ways:

"Sandy or gravelly soils absorb heat more rapidly and retain the heat longer than loam or clay do, and are therefore reckoned warmer and 'earlier' soils. Dark-coloured soils absorb more heat than light-coloured ones, so, therefore, peaty and humous soils are warmer and earlier than whitish, chalky soils. The more moisture in a soil, the more of the sun's heat is used in warming up and evaporating this water, so that the temperature of the soil itself will be raised more slowly, and it will cool proportionately more quickly; therefore, damp soils are cold and 'late.' The aspect of a soil, as facing south against facing north, will much affect the amount of the heat received from the sun, taking either any day of any season or the whole year. The inclination of any field will influence the amount of heat received from the sun; a plain will receive less than a sloping field inclined to the south, and a slope to the north least of all."

Summary.—Generally speaking, it may be taken that fowls with white flesh do best on light soils; with grey flesh and legs on medium soils; those with yellow flesh and legs on heavy soils. There can be no question that as a rule the finest eggs are produced upon the heavier lands. In respect to the above, mention is not made of sandy soil, because this is of much less use, although dry, for poultry-keeping. The fact is, the herbage upon any soil determines its value for stock purposes, and if the soil is not good enough to grow plant life, it is of a low standard of value for poultry. Many people have an erroneous impression with regard to sand, and we frequently have to state that we should prefer the heaviest land that was ever ploughed to pure sand for poultry-keeping.

Soils in Relation to Breeds.—In view of what is stated above as to suitability of soils and climate to the respective breeds, we can only generalize in this direction, as there is often great

* "Agricultural Geology," 1902, pp. 134, 135.

difference in constitutional vigour of varieties of the same breed, even of the respective strains. The following will give a general idea in this direction, in so far as those races and varieties are concerned referred to in Chapter III.

Fowls.

Egg Production.—In this I include both the non-sitters and general purpose breeds—the former as the more prolific, the latter as better layers in winter.

Position.	Breeds recommended.
Cold, exposed situations, or clay soils	Ancona. Leghorn. Plymouth Rock. Rhode Island Red. Wyandotte.
Medium soils	Brackel. Campine. Houdan. Minorca. Redcap. Scotch Grey. Faverolle. Orpington.
Gravelly or light soils	All races named above.

Flesh Production.—Whilst the better classes of table chickens cannot be produced on heavier lands, good birds may be reared, though probably with yellow or creamy flesh. It is important, however, that these should not be chosen from the more tender breeds.

Position.	Breeds recommended.
Clay soils	Langshan. Black Orpington. Plymouth Rock. Wyandotte.
Medium soils	Scotch Grey. Bresse. Faverolle. Buff and White Orpington. Maline.
Gravelly or light soils	Dorking. Game. Sussex. Other French breeds.

Crosses.—So far as these are concerned, it is needless to describe them. Enough if it be stated that the colour of leg and skin as shown above should be a guide to selection for crossing, and that it is unwise to attempt rearing high-class table birds on heavy land. Other suggestions are made in Chapter III.

Water-Fowl and Turkeys

Ducks ..	Gravelly soils in valleys with streams most suitable; high lands not so good in summer; peaty soils excellent; marshy, undrained land to be avoided.
Geese ..	For hatching and rearing, down and hill land preferable; for feeding off, heavy arable land and medium pastures.
Turkeys ..	Clay or damp land fatal; should be kept on medium or light soil; well-drained, hilly land excellent.

Change of Conditions and Environment.—In connection with larger stocks it is recognized that as a rule manifest benefits arise from change of conditions, but hitherto the importance of such change has not received much attention at the hands of poultry breeders. We realize that it would not pay the latter to send their birds away during the period of growth on to a different soil, as is frequently done by breeders of the heavier type of horses; our point is, that sometimes it is desirable to change the special branch of poultry husbandry followed, or, at any rate, to change the class of fowl kept. The latter would be preferable, and sometimes it would be advantageous, especially where the poultry-keeping has been intensive, to remove all fowls from the soil for three or four years, in order that the ground may have a rest in the same way as takes place in the rotation of crops. My object at the present time, however, is not to deal with the matter in that direction so much as to show the influence of change of soil upon the birds themselves.

I have already indicated that many of the variations which take place are the result of changed conditions, but it has not yet been generally recognized that an important benefit may be obtained by the fowls when removed from one place to another. Change of environment influences more especially growth and productiveness, though it also modifies characteristics. The late Charles Darwin, in one of his works, quoting the remarks of a well-known breeder, mentions this influence, and says: "It is a well-known fact that a change of soil and climate effect perhaps as great a change in the constitution as would result from an infusion of fresh blood."* He, however, shows that the change is not always beneficial. In some cases the reverse is the result, for there are instances on record where changed conditions in the case of domesticated animals have distinctly led to infertility. Infertility may, however, be due to other causes, and as a rule it is owing to a reduction in the virility of stock. In the temperate zones, except such birds as are kept in strict confinement, the

* "Animals and Plants under Domestication," 1885, vol. ii., p. 94.

fowl generally breeds without any difficulty. I have known, however, a race which at one place were specially characterized by great egg production or by flesh qualities, and yet which, removed to another place, were distinctly inferior in these directions. The point which it is desirable for the breeder to keep constantly in view is, that variety of conditions seems to be absolutely necessary to maintain our birds in full vigour, and that one of the most important considerations is that we should as far as possible endeavour to recognize influences which will make for success.

It was suggested by Darwin that change of conditions would have considerable influence in maintaining the stamina of our races of animals and birds, for he says in another place: "It is a law of Nature that all organic beings should occasionally cross, but it appeared to me probable that the good derived from slight changes in the conditions of life from being an analogous phenomenon might serve this purpose. No two individuals, and still less varieties, are absolutely alike in constitution and structure, and when the germ of one is fertilized by the male element of another, we may believe that it is acted on in a somewhat similar manner to an individual when exposed to slightly changed conditions."*

Application in Practice.—We must remember that the systems which are found successful in connection with plant life are in many instances equally applicable to our animals. No practical farmer would think of growing the same crop year after year upon one field, which fact has led to rotation in farming. Also in connection with gardening it is found necessary, where the ground is occupied for a succession of years with a similar crop, to use seed which has been produced elsewhere, and in that case practically what we are advocating is carried out. If the seed obtained from any crop were employed again upon the land where the crop had been gathered, very speedily degeneracy would result, and there would be both a lessened quantity and quality of produce. What is true in this case is equally so with poultry, and, in fact, were it fully recognized, much of the advocacy of fresh blood is due to the recognition by practical experience of the fact that stock kept upon the same land gradually loses its vigour and its productiveness, or, to quite the remarks of an experienced farmer many years ago, published in the *Gardener's Chronicle and Agricultural Gazette* (1850): "Nothing can be more clearly established in agriculture than that growth of any one variety in the same district makes it liable to deterioration either in quality or

* "Animals and Plants under Domestication," 1885, vol. ii., p. 127.

quantity." Sometimes we meet with instances where fowls are kept upon land for several years, and the measure of success realized at first is not maintained. Perhaps fresh stock is then introduced, and it is found that these grow better and are much more productive. To this cause may be attributed the favour with which new breeds of poultry are frequently regarded, and often the credit which is given to the fowls themselves does not really belong to them, the fact being that the greater success achieved is due to the new conditions rather than to any instrinic merits of the birds. I believe, therefore, that an interchange is absolutely required, and that very often the great success, both as to egg production and also to meat qualities, found when fowls are removed from one country to another, is attributable to the stimulus given under the entirely new conditions.

Many poultry-keepers, when they are purchasing fresh stock, buy them as near home as possible in order to save themselves trouble. Where the place from which the birds are purchased is sufficiently varied, this does not matter. We know that in the British Isles there is a great diversity of conditions. Within a radius of two or three miles we may have three or four different classes of soil, and also very different altitudes. Under these circumstances the change desired is obtained, but as a rule it would be wiser to go much farther afield, securing birds which have been raised, perhaps, for two or three generations under absolutely different conditions, and, as far as possible, upon different soil. A further direction in which much can be done is in the raising of chickens, even upon one farm where a large area is covered. For instance, supposing that the land is undulating, or in the hilly districts comprises both high and low land, then it would be advantageous to rear the birds upon different soil from where the breeding stock are maintained. Much can be accomplished in this way to overcome the undoubted disadvantages which arise from keeping fowls under domestication.

North versus South.—Some years ago the late Louis Van der Snickt, of Brussels, suggested that change of conditions is responsible for variations in egg and flesh production, generally attributed to other causes. He pointed out that wild birds come north for the breeding season. In the doing so expenditure of physical energy reduces the reserves of fat accumulated under milder conditions. Not alone is that the case, but the colder and more bracing air stimulates the breeding activities. From that fact he deduced that in connection with poultry, even though these species are non-migratory except in the case of wild ducks and geese, a similar racial influence is exerted upon birds transferred from the country they have long lived in to another, so long as the new habitat is not an extreme. As the late Charles Darwin pointed out:* "The fowl, a native of the hot jungles of India, becomes more fertile than its parent stock in every quarter of the world until we advance as far north as Greenland and North Siberia, where this bird will not breed." That other influences are in operation is certain. At the same time my own observations since the suggestion was first made have supported the theory. All the Mediterranean races of fowls are better layers in Northern Europe than in the South. And other evidence is that birds of a hardy type transferred from even milder areas to more bracing conditions are usually productive to a greater extent than before, apart altogether from questions of feeding and management, probably owing in some measure to the greater activity of body thus induced to meet the more rigorous conditions. On the other hand, birds transferred from colder to warmer countries, as from an upland district to a lower-lying, milder environment tend to lethargy of habit and to increase of flesh. That is well known in the case of cattle and sheep, and I see no reason why it should not be equally true with poultry. What is here stated is of considerable importance to breeders if they keep in mind that it does not apply to great extremes of heat or cold.

* "Animals and Plants under Domestication," 1885, vol. ii., p. 145.

CHAPTER VII

POULTRY HUSBANDRY ON FARMS

The most profitable and promising method of developing poultry husbandry is as part of the farm operations of any country. That must be the basis, and will ever be the main source of supply. Breeding poultry farms and even specialist plants may have their place in the general scheme, as has already been stated, and is more fully dealt with in later chapters. Such, however, are merely contributory, and of the lesser importance in relation to food production. In newer lands progression may be encouraged by establishment of specialist farms, in which the sale of breeding stock is made a leading feature. There, however, population is usually scanty, and operations are generally on a larger scale in other sections of agriculture. Among the older countries where the soil is more or less fully in occupation, the chief method for development of the food resources in connection with poultry husbandry is by extension as far as possible upon each individual farm and holding, in accordance with its capacity and in due relation to its other branches. That was the ideal which impressed itself upon my mind when I began to study this question more than thirty-five years ago, since which time it has grown steadily as a result of wider experience and observation. What is here stated is evident everywhere. When in America the Hon. James Wilson, at that period Minister of Agriculture, informed me that 95 per cent. of the eggs and poultry marketed in the United States were produced upon ordinary farms. In Denmark it was stated that the proportion was 99 per cent. In France and all Continental countries the same is true, as in Ireland. In Britain, even if we take into account the vast multitude of smaller poultry-keepers who in this way supply their own household needs, together with amateurs and specialist breeders, I question whether their share of production is equal to 10 per cent. of the total. Hence the importance of advancing and developing poultry husbandry in this country as an integral part of agriculture, not alone to meet the already enormous demand, but in anticipation of future requirements.

Eggs or Flesh.—Even upon farms, however, there must be a definite aim in respect to the poultry section. Too long have haphazard methods been the dominant factor. Whilst a hen is ever a hen, there are wide differences in productiveness, as shown above. It is essential, therefore, that consideration should be given to—(1) the capacity of the farm, (2) the nature of the climate and soil, and (3) the product which will yield the highest returns in accordance with market demands. On these questions more is said later, and need only now be mentioned.

Generally speaking, and taking the country as a whole, the majority of farmers find that egg production is the most paying part of their poultry operations, by reason of the fact that the demand for eggs is to be met with in almost every section of the country, and is practically always greater than the supply, whilst it is rapidly advancing, and prices are as a rule good except where the quantity available is very limited or the local organization for marketing is at fault. A further fact is that egg production entails less labour than table poultry. There are, however, exceptions, such as in the south-eastern counties of England, where there is a constant demand for chickens on the part of fatteners; in Buckinghamshire and one or two other counties, where duck-breeding forms an important industry; and in East Anglia, where turkey-breeding has received a large amount of attention. That these might be duplicated elsewhere I do not doubt. It is useless, however, producing high-class poultry unless there is a market for it. In the case of fowls a prime essential is the proximity of fattening centres where the birds can be finished off, for lean fowls, if to be killed forthwith, are of much less value than when they are to be fed off. Unless a profitable outlet is at hand, the rearing of such birds would be in vain. Moreover, to secure a trade there must be a fairly regular supply, and that can only be accomplished where a considerable number of people within a given area are operating on similar lines. No ordinary farmer could produce on a sufficiently large scale to satisfy traders, who do not want driblets at uncertain intervals. The same is true of ducks and turkeys. It must be by either big poultry farms, which are unprofitable, or the contributory efforts of a number of farmers. The latter I have advocated as alone capable of solving this problem.

In order not to be misunderstood, I acknowledge that the farmer who makes egg production his main object will have chickens and old hens for sale at certain seasons, and must make the best of them ; and that the breeder of table poultry will also have to dispose of eggs not required for hatching. Further, there are districts, such as near holiday resorts, where eggs can always be sold, and fair quality poultry may be disposed of during the season. Where that is so, plans should be made accordingly.

"**Pin Money.**"—Where the number of fowls maintained upon any occupation is comparatively small, then the simplest, easiest, and cheapest method is by allowing them to live around the homestead, finding the greater part of their food there, and sleeping in one of the farm buildings. Such is the picturesque side of farm poultry husbandry, as revealed in the paintings of John Herring, of my old friend the late Harrison Weir, and others. Usually the flock is a mixed one: fowls in the greater proportion, a few ducks, perhaps some geese and turkeys. Properly controlled and managed I do not think there is any side which yields an equal return for the outlay, even though the corn which the farmer's good wife gets for nothing be charged as a debit. That, however, may be termed "pin-money poultry-keeping." From this she is able to obtain many little things without asking her husband for cash to buy them. Within strict limitations, such a method is successful in countries of small occupations by the aggregation of produce from many individuals, as in Russia to a considerable extent. It does, however, not exhaust the capacity of even these lands, and merely touches the fringe of what may be done where the holdings are larger. It is evident that the method here referred to involves a strict limitation of the number of poultry kept, otherwise by concentration upon a comparatively small area the soil becomes in the course of years "fowl sick"—that is, impregnated with manurial elements. Therefore, where such a system is adopted, and I recognize that in some instances no other is possible, the number of adults must be kept down in accordance with the conditions. What that number should be it is difficult to state. The determining factor is the extent of the farmyard and adjacent paddocks. Usually twenty to forty will be quite sufficient. Nearly all the great poultry epidemics observed have been due to increase of numbers without modification of method, and that is also true upon individual farms. A note of one of these latter will suffice to illustrate my point. On a Midland county farm the complaint was made that a good many of the older birds were dying, and there was a great difficulty in rearing chickens. Inquiries revealed the fact that the number of the former had within recent years been more than doubled, and that chicks had been raised for more than thirty years on one field adjacent to the house. So long as the operations were small no evil effect was noticed. It was by keeping numbers in excess of the capacity that the result stated had followed.

Homestead Methods.—So far as housing the fowls is concerned, the principles which are laid down in Chapter XI. should be carefully observed. There are, however, a few points which may be specially emphasized—namely, that there must be no overcrowding in the roosting quarters. The capacity of air-space in a poultry house should be at least 10 cubic feet per inmate—that is, for each fowl. Ducks, geese, and turkeys, should be separately provided for. The two last named, however, require at least 40 cubic feet of air-space for each bird, and these are better if differently treated, as described in Chapters XIX. and XX. Reverting to permanent houses for fowls, the common mistake is made of building so that light and ventilation are inadequate. It is impossible to urge too strongly the requirements mentioned. It would be a simple matter to alter most of these buildings to the open-fronted form, which would at once solve the problem referred to, in so far as the points named are concerned. The old notion as to conservation of warmth being conducive to prolificacy, and arriving thereat by restricting the circulation of air, is exploded. As homestead fowls are able to obtain plenty of exercise, scratching sheds are not required.

The natural methods of hatching and rearing described in Chapters XV. and XVI. are usually found most suitable for this class of poultry husbandry, provided that the chickens can be hatched early enough to come into lay the following autumn. That will depend to some degree upon the breed kept. If it be a non-sitter artificial systems must be introduced. In any case, however, an incubator will be valuable, in order that the time of hatching shall be under control. In this connection supremely important is it that the rearing ground shall not always be the same. On few farms is it impossible to insure variation in this respect between one season and another.

There is a branch of poultry work for which the homestead system is specially suited, as met with in the south-eastern counties of England and in some sections of Ireland—namely, rearing chickens for sale to fatteners. On an ordinary small farm, by keeping a flock of, say, twenty-five breeders, two to three hundred chickens can be raised annually. Under such circumstances an incubator and brooder are necessary for securing early chicks, and especial care must be taken to provide fresh rearing and growing grounds every year.

Distributive Methods.—It is evident that the system referred to above must seriously limit the egg and poultry production of any country where the farms are of a fair size. That explains the figures in Chapter I., as to the average number of poultry in Great Britain. Therefore, a prime necessity for increase is that the birds shall be distributed over the land, form an integral part of the operations, and in rotation with the crops, whatever these may be. Alone in that way can the capacity of production be developed. Taking a 100-acre farm with fair-sized buildings, if all the fowls are to be concentrated around the homestead it would be inadvisable to keep more than thirty to forty adults, or fifty at most. The highest of these figures would only represent half a fowl per acre of cultivated land, which is a little under the actual average on all the farms of Great Britain. Were the farm larger, say of 300 acres, not a great number more could be profitably maintained under that system. Thus we see why the larger the farm the smaller *pro rata* the poultry population. It is the method, not the possibility, that is at fault.

Unless, therefore, what are known as extensive methods are adopted, it is impossible to look for that increased production towards which we are striving. This fact was recognized in the latter part of the nineteenth century, leading in some sections of the country to an advance which, small as compared with what may yet be, has been considerable. My own calculation, based upon evidence it would take too much space to give in detail, is that the total annual value of eggs and poultry produced in the United Kingdom has increased by £5,000,000 within the last twenty years. As yet, however, the possibilities have only been realized by a few. In many counties the old methods still are paramount. What we have to do is to secure the adoption of those which are referred to below.

Portable Houses.—There are two ways in which the extensive system can be carried out—namely, by use of portable houses, or by what is known as the colony method. As the latter is specially suited to small farms and allotments, although it can be adopted on larger farms, information as to it will be found in the next chapter, and I now deal with the former.

Many forms of portable houses are used. So long as these conform to the principles laid down in Chapter XI. the shape and build do not so much matter. As the main object is to distribute the fowls in relation to the cropping, it is, as a question of labour, desirable that these shall be easily removable from one field to another, or even on the same field. To do that frequently and easily the size must be limited, otherwise it would be too heavy and cumbersome. Usually we find that the sizes most useful in this direction are 7 feet long by 5 feet deep, or 5 feet long by 5 feet deep, the former of which will accommodate about twenty fowls, and the latter fifteen. For breeding flocks consisting of ten inmates a useful size is 5 feet long by 4 feet deep. It is false economy to overcrowd the birds, and a little additional floor space is no disadvantage. For reasons given in Chapter XXI., where hens are kept for egg production the unit should be about twenty-five in each house.

In building a structure of this class the most important consideration is to have a stout frame, otherwise it will not stand the strain of frequent removal. That is specially true so far as the bottom joists are concerned, and it must be strongly built.

Enclosed Yards.—As a general principle in connection with farm poultry wire netting is not required, as the essential factor is distribution over the land and freedom for the birds. It is frequently, however, a great convenience to have a few houses and runs in a suitable location near the homestead for special purposes and at special seasons. Such are not required for breeding pens unless some test is being made. In practice two or three such flocks can be kept at liberty in a single field, if of a fair size, without danger of mixing, provided that there is an active male bird with each lot of hens and they have separate houses. Where very early eggs are wanted for hatching, the plan of bringing one or more flocks nearer home is often desirable, as they can receive attention with greater facility, and also be sheltered during very unfavourable weather, such as snowstorms. Enclosed yards of this nature may be used for isolating male birds, for chickens that are not old enough to be put out on range, for old hens that are selected for sale, for fresh stock which are to be kept under observation before they are placed with the rest, and for many other purposes. In each run a portable house should be placed, which may at other times be used in the ordinary manner on the fields.

Class of Stock.—What has already been stated in Chapters III. and IV. should be carefully studied, for success or failure will in part be determined by a right class of birds, properly selected and mated. The same is also true in respect to observations made as to the number which should be maintained. Upon these points, therefore, not much need be added. We do not expect farm poultry to have the same high standard of racial excellence as those which are bred under other conditions. They may even appear to be rougher and of an inferior type, though that is merely on the surface. Profit will be determined by productiveness. Primary selection should in such cases be in accordance with known qualities as far as possible, or with such type as appears contributory in that direction. What has been said as to vigour of constitution is an important consideration, especially in view of the fact that the general conditions on a farm are more rigid than on smaller plants. Farmers are not breeding to exhibition standards, and they are well advised to treat these in an easy manner, whilst keeping racial characters pure. The choice of breed has already been fully dealt with. What is required is to avoid intermixing, and to pay special attention to the family record of male birds purchased. As a rule it is only necessary to buy one or two of these every one or two years, if the breeding operations are on systematic lines.

Risks of Loss.—I have in Chapter II. dealt frankly with the fox question. The claim is sometimes made that farmers ought to protect their fowls by wire netting and shutting up early in the afternoon. The former would add greatly to the cost of equipment, the latter to the labour, neither of which the farmer has any right to bear. In fact, the onus for protection against loss is on those who are responsible for preservation of these troublesome vermin. In these days farmers are justified in demanding that they shall not be penalized in this manner. Within the immediate future their position will be much stronger. Where foxes are troublesome a trapdoor is useful at night, though troublesome to the owner who desires his birds to be out in order to catch the " early worm."

At one time in some districts there were many complaints of theft among birds on range. Happily that is not now so prevalent. Thieves there will always be, and these must be dealt with in other ways.

Rooks and some other wild birds often give trouble by carrying off young chickens. These enemies must be shot down. On smaller occupations cats and rats are great nuisances, and the loss is often considerable. Shooting the former and killing the latter by other means must be left to such ingenuity as can be devised.

Hatching and Rearing.—The reader is referred to the chapters dealing with Hatching and Rearing and General Management for detailed descriptions of methods and appliances. There are, however, one or two points which it is fitting should here be mentioned. First of these is the importance of much earlier hatching upon farms than is customary. My observations have frequently shown that the general size of chickens met with in the month of June is what ought to be seen in April, or at least early May. This may be and often is due to lack of broody hens, not the want of fertile eggs. The question is discussed in later chapters from special aspects—namely, the influence of earlier hatching upon supplies of eggs in winter, and the time for marketing chickens and ducklings. What we require to aim for is bringing forward the period of hatching by something like a month, though in this respect the conditions of each farm must be considered. Where the situation is colder and more exposed, especially if at a higher elevation, hens are often later in laying and becoming broody, so that a month would scarcely be enough. In order to control the time of hatching, an incubator is a most valuable appliance, even though it may be used only once in a season. Where the line of profit is in the direction of raising birds for killing, the importance of hatching early is very great. In that case it is necessary to enhance growth and secure early maturity, and special methods are essential. Generally, however, the better plan is to rear the birds on range, to harden them by compelling exercise, and allow them to forage over as wide an area as is available.

Water-Fowl and Turkeys.—Specialization is the order of the day in almost every branch of life. Frequently that is the line of success. To a considerable extent this is desirable in respect to poultry, upon larger farms as well as on smaller occupations. Unless, therefore, the different branches can be kept distinct, which to a large extent is a question of efficient labour, it is much wiser not to complicate the problem by attempting more than one of these except as subsidiary to the main object. What I am now urging is that the different branches should not be mixed, as is so often the case, disseminating over a few birds of the four species of poultry efforts that would give greater success if concentrated on any one. Such farmers as go in for duck-raising —and under suitable conditions and methods there is no more profitable side of poultry husbandry—should concentrate their attention upon that, unless they can take up some other on distinctive lines under separate management. As a general rule, except upon rough grazings, geese cannot be recommended as profitable stock, although a lot of goslings may be bought after harvest and put out on the stubbles in arable districts. Upon this branch of the pursuit more will be found in Chapter XIX. And in the case of turkeys, with regard to which are great possibilities as yet unrealized by larger farmers, the wise course to adopt is to specialize on these birds, and not to breed merely a few as part of a general stock of poultry. Mixed cultivation may be desirable and profitable. Upon that I am not qualified to express an opinion. It is, however, certain that mixed poultry-keeping is economically a mistake.

A Cambridgeshire Example.—In Chapter II. reference will be found to the enterprise of Messrs. J. Chivers and Sons, of Histon, upon whose fruit farms, embracing more than a thousand acres, poultry are now being kept in large numbers. Such is exceptional as to the extent of operations. At the same time, however, the principles adopted, which are simple in the extreme, could be duplicated elsewhere on a scale relative to the size of orchards. The houses in use are of an ordinary type, capable of removal as that may be required. These are distributed among the fruit groves. As a result natural food is obtained in abundance; the fowls live to a considerable degree on the parasites which prey upon the trees. In every sense the method adopted is extensive—that is, distributive. Concentration is alone found at what may be regarded as the centre of the enterprise—that is, where are the buildings for hatching and fattening. Here is a fine incubator house, food stores, and a fattening shed, with a number of other buildings. Surrounded by orchards, the chickens, whether under hens or in brooders, are placed out between the rows of trees and bushes, under what are ideal conditions. Spread about in this way, there is no danger of debilitation or of disease in young or old birds as a result of tainted soil, and, as stated previously, the amount of natural food obtainable is so large that at some seasons of the year very little indeed has to be supplied. Upon the entire place I did not see a foot of wire netting, which as a rule is unnecessary and undesirable on farms of a fair size. Excellent results have been obtained in respect to both eggs and table poultry; and whilst the average egg production under such conditions will not equal those obtained as a result of more intensive methods, profit should be actually greater, due to the reduced cost of equipment and lesser annual charges for food, labour, and general upkeep. The eggs obtained are mainly used in the works of this firm at Histon, but are charged at current market prices. What is being done here is capable of reduplication on nearly all the orchard lands throughout the country. My own observations on the vineyards of South-Western France and the orchards of Normandy are thus fully confirmed. Here, it is well to remember, the poultry are subsidiary to fruit cultivation, which must always be the case on larger and even many smaller fruit farms. In that direction, however, the capacity for development is enormous.

A Belgian Method.—In spite of the fact that recently a most disastrous epidemic has decimated the poultry husbandry of Belgium, and that among others the farm about to be described has suffered heavily, I refer to it because there are features of considerable interest. Such losses as have taken place are attributable to causes which might have been avoided, and not to the system itself. Breeding from immature and forced stock has so reduced the power of resistance that degeneracy has naturally supervened, together with neglect of hygienic precautions. The story is fully told in my "Report on the Poultry Industry in Belgium." The Viscomte de Beughem owns an estate in the Lippeloo district of East Flanders, and he has for some years reared a large number of the famous *poulets de Bruxelles*. Every autumn about 600 Malines pullets are distributed with male birds among the farms on the estate, from thirty to fifty on each place. These remain the property of the Viscomte, and have usually been replaced every year. The farmers feed and care for the birds, and are bound to sell the eggs back to him, the prices paid varying from 1d. to nearly 2d. each, according to the season. These eggs are incubated at the Château de Melis, the chickens reared during the earlier stages within enclosed runs, and afterwards out in the woods, and finally sold to the fatteners. So far as these arrangements are concerned—that is, when the term of life is brief—no harm could possibly result. The failure has been due to the fact that all the chickens are forced for size by keeping under the conditions named, and that selection of the breeders has been from these birds. No attempt was made to conserve virility by use of fully-matured stock, and by rearing those intended for reproductive purposes in a manner calculated to maintain and develop constitutional vigour. That the system, if worked out on better lines, could be made permanently successful, as was the case for the first few years, I do not doubt, though considerable modification of method would have to be adopted from that followed at Lippeloo. In the next chapter will be found particulars of a somewhat different system which I met with in America.

Rough Grazings.—Where the land is rough and the country open, much might be done to increase the breeding of poultry. That, however, would have to be on a totally different principle, due mainly to the fact that success is dependent largely upon the human factor, and the population is sparse in these districts.

Poultry cannot be put out on the hillsides, as can cattle or sheep, and left to themselves. Farmers and labourers living under such conditions may do much more than at present, though at first on a moderate scale. The equipment required would consist of a few portable houses which can be scattered about during the more favourable months of the year, say from March to October, and then be brought nearer home. The chief source of profit would be by sale of grown chickens as breeding or laying stock, for which, if the supply were adequate, I believe a great demand could be created. Hatching operations should commence as early as fertile eggs are obtainable, and the chickens be given full range as soon as the infantile period has passed. In this way the cost of rearing would be small, and the birds be of a vigorous type. Under such conditions, usually the more vigorous and hardier races would have to be kept, such as the non-sitters and general purpose breeds, though on some of the kindlier soils I should be glad to see a trial made of rearing chickens for sale to fatteners, which if carried out over a fair area should provide a fairly regular supply. As an instance, Dorkings have thriven excellently on the dry hill-lands of Cumberland and Westmorland; and that being so, other races might be equally successful.

Labour.—So far as larger farms are concerned, the main difficulty has been absence of knowledge in the principles of poultry husbandry on the part of farm workers, who in too many cases, like their masters, have thought hens of small moment, and that anything would do for poultry. I am not now speaking of skilled poultrymen, of whom the supply is all too few, but of agricultural workers. Not many farmers would find it worth their while to engage labour for this purpose alone. What they want is a man who can attend to poultry as part of his work. During the past few years I have had many inquiries for such men, and very seldom knew where to find them. This is an important point, and has undoubtedly hindered development. When, therefore, the business contemplated was beyond the scope of his wife or daughter—that is, was extensive rather than concentrated—the labour question has often been the main difficulty. The specialist, man or woman, is of no use in this way. What will have to be done is to gradually train the younger generation, and, with a largely increased number of small holdings upon which poultry occupy an important place, we may hope that the sons and daughters of the next generation will be more familiar with this branch than is now the case. Instruction in poultry husbandry has generally been beyond the reach of this class, and in the areas where most needed is given least.

CHAPTER VIII

POULTRY ON SMALL HOLDINGS AND ALLOTMENTS

The term "small holding" is now regarded as applying to all occupations from 5 to 50 acres in extent, whilst "allotment" is understood to mean those of less than 5 acres. It is impossible, however, to limit ourselves in this way, for in many instances what can be done on a farm of 100 acres may be applied with equal success on one half that area. As a rule, however, save on poorer lands, small holdings are usually under 30 acres, and there is every prospect that the number of these will increase. Of the total number of agricultural holdings in England and Wales in 1912, 46 per cent. were within the designation given above, whilst the average acreage of these was a fraction under 20 acres. Of allotments, leaving out those of less than an acre in extent, the number in the year named comprised 21 per cent. of the total, and the average size was a fraction over 3 acres. It is well to keep these facts in mind when studying what is recommended below.

Small Holdings.—Taking this class of farm as a basis, it is evident either that, if a living is to be obtained, the standard of life must be a low one, or the production be enhanced considerably above what is usually found on larger farms. Size of occupation has its importance, as have the nature of the land, the labour required, and the capital expended. The great difference, however, between results obtained on farms of the same acreage is not so much the soil or position, but how it is cultivated and stocked. My point is that small holders must produce more per acre than larger farmers if they are to reap an adequate return and make a living therefrom. Therefore the poultry operations must be on more intensive lines—that is, the land must be utilized to the full. As shown in Chapter I., the number of poultry kept usually decreases *pro rata* to the increased size of holding. It is from the smaller occupations we obtain the bulk of native eggs and poultry marketed, which is also true in every country. Future development will depend in large measure upon extension of this class of the rural community. That such increase would do much to add to the fertility and productiveness of the soil is an important consideration. To that end poultry will contribute very greatly.

What has been stated in the previous chapter as to stock and equipment applies also to smaller holdings, as does the relative number of poultry kept to the acre. It is more profitable to permanently maintain three adult fowls per acre, which can be done without interference with the ordinary course of cropping, than to keep a larger number, and later on be compelled compulsorily to reduce the stock. If distributed about the holding in the way already described, and linked with cultivation, on a 20-acre farm sixty layers and breeders may all the time form the standing stock of fowls. From these a profit of 5s. per hen per annum over the food cost should be secured; and if a couple of hundred chickens are bred every season, a further profit of £10 should be returned, making in all £25 yearly from this branch of the operations. Larger holdings could increase the stock to a similar proportion. Properly managed, at least 25s. per week profit should be realized on a 50-acre farm. If, however, distribution cannot be carried out, and the birds must be kept around the homestead, the stock should be correspondingly decreased in number.

Stock and Equipment.—The first season it would be desirable to buy eight to ten hens and a cock as the basis of the stock, breeding from these, in addition to which a dozen or two day-old chicks of the same breed can be obtained, and thus provide the interchange of blood desirable. From such a foundation the small holder should be able to build up his flocks of breeders and layers. Under these circumstances he will as a commencement need one poultry house and a few coops or a brooder. In fact, as a temporary expedient he may make shift with a very rough-and-ready erection for the breeding-pen, so long as it is well ventilated and the birds have plenty of space to wander about, or utilize an existing building. In these days poultry houses can be purchased at remarkably low prices. It will not tax his capital unduly, therefore, to buy his first house, as he is certain to be very busy in other ways. He may later on construct what others will be required as opportunity permits. Often materials can be obtained cheaply which answer excellently for this purpose. Packing-cases of various kinds will do admirably, provided the wood is substantial and durable. Even if new timber has to be purchased, considerable saving can be made in cost by the method suggested.

The point must here be emphasized that every house should be portable, which does not necessarily mean that it should be on wheels, but that its size and construction should be such that it can be easily removed to another location. Large fixed houses are a mistake under the conditions here referred to, not alone from the fact that to move them means heavy labour and expense, but also that the difficulty of doing so frequently results in keeping fowls too long on one place, and consequent tainting of the ground. There is always a temptation to build long-range houses, as described in Chapter X., but that I regard as undesirable for the small holder. Few poultry-keepers who have put down fixed houses have not ultimately found that changes might be made with advantage, and have experienced loss arising from want of plasticity in their equipment. It is not suggested that no houses are to be used which need not be moved for a long period, perhaps several years; if these are built in sections or are not too big to transfer on rollers, the owner is master of the position, and can transpose them if he thinks it desirable to do so. The ordinary portable houses on wheels or runners are to be recommended for use on the open fields, as they can be moved from place to place in a few minutes, and offer the great advantage of preventing any damage to grass, and of causing a wider distribution of the manure, by which the land and crops will greatly benefit. In this way convenience of the owner and health of the inmates are both provided for, and the work is not hindered by rigidity. This system will not overtax either the resources or the labour of any hard-working small holder, and if properly carried out has all the elements of permanency.

The Colony System.—Alternative to the distributive method is that known under this name, and which, I am convinced, has great advantages. Probably upon small holdings and allotments alike, except very small plots, it will yield the greatest amount of return. In short, I feel convinced that development of the poultry industry is largely dependent upon adoption of this method. Below are described several places where the plan has been successfully carried out. There are, however, a few points which require elucidation. Upon attention to these success will largely depend. The one disadvantage is that there may be a slightly increased cost of equipment as compared with the distributive method, though that is not always the case. It will also be found necessary to isolate the birds by wire netting, especially if the adjoining land be in vegetables or small fruit. If the land is arable or pasture that is seldom required. As compensation there is a considerable saving of labour. The birds are concentrated, and can all be attended to at once. Further, by the colony method a larger stock can be kept in proportion to the total acreage. The principle is that the birds are kept thickly on one place for twelve months, when they are bodily removed to fresh ground, that vacated not being used again for poultry until three years have elapsed, during which time it is cropped fully each season so as to exhaust and utilize the manure. The last-named is essential to complete success—that is, poultry must form one in a four-course rotation. If such a principle could be generally adopted, the doing so would prevent much loss in virility and by disease.

A Hertfordshire Farm.—Mr. T. W. Toovey, of King's Langley, Herts, has for many years experimentalized as to poultry husbandry, gaining valuable experience. Reference is made to his operations in Chapter X. This breeder is always ready to test any new system, and publishes freely the results arrived at. On one of his farms he has adopted a colony method which has special features. This is on high arable land, fully exposed. After use thickly by poultry for a year, during the next four or five years it is cultivated, and the influence upon the crops, as compared with what was the case formerly on this land, is very great indeed. At first larger-sized houses were used. It was found, however, that the fowls crowded a few of these, leaving the others empty, and that during the prevalence of strong winds the houses were frequently blown over. In place of these, very small low-roofed erections are employed, which are best described as very large-barred fronted coops. These are grouped in lots of fourteen, seven in a row, each row facing the other, with a narrow avenue between. The first two of these huts at each end are chained together, which has been found necessary as a defence against strong winds. That is sufficient, for if the first two were blown over all the rest would follow. If they are firm those between do not move. Within the rows are placed laying boxes separate from the coops. Each lot of fourteen houses is enclosed in a netted run of half an acre, on which about a hundred birds are kept. In these runs are placed shelter sheds for protection during the daytime, and the position compels them to forage about to keep themselves warm. It may be stated that the fields are open, as a consequence of which the wire netting referred to has to be used, otherwise the birds would trespass on the cultivated portions. Mr. Toovey states that "when eggs are scarcest, the most exposed birds have done the best."

Rhode Island, U.S.A.—It was in this State that I first saw the colony system adopted on a considerable scale, and in association with general farming, yet systematized and conducted on definite lines. I have never seen, not even in the most important poultry districts of Europe, so many poultry houses within the same area. To such an extent has this pursuit grown that nearly every farm in the Little Compton district has a larger or smaller number. The method was first introduced nearly seventy years ago, gradually extending as demand for produce has grown, Boston being the chief market. Instead of long-range poultry houses, which are often adopted on poultry farms, the huts are separate, grouped upon one part of the farm, and the whole removed to another part at the end of a year. The houses, shown in Plate II., are usually 8 by 12 feet, and 6 feet high, with gabled roofs. They have large windows in front, which can be opened, and the usual trap entrance for hens. Inside they are fitted with perches and nests, and, as there is no floor, the earth is thickly covered with sea-sand. In the majority of cases cattle are kept on the fields at the same time as the fowls, and where that is done the customary plan is to fix a rail fence around the house to keep the stock away from the water vessels and food troughs. Each house is designed to hold thirty-five to forty fowls, and the customary plan is to allocate one such house to an acre of land. Thus, on a farm with, say, 1,000 layers there would be about thirty houses, and a corresponding number of acres would be occupied. It will be seen, therefore, that there is no overcrowding, and that the balance between animal and plant life is well maintained. In addition to the area referred to, a further portion of the land is required for chickens, and usually about 400 can be reared to the acre thus in use, which does not mean that the number is present at one time, for such is the yearly average. The cost of feeding was stated to be about 3s. 4d. per head per annum, as the birds obtain a considerable amount of natural food, and the average profit given to me was one dollar (4s. 2d.) yearly. Under such circumstances, as also the two other instances described in the following paragraphs, whilst it is true poultry and eggs form, it may be, the leading production of these farms, by avoidance of overstocking and prevention of tainted soil, in combination with other branches of agriculture, a good living and something more is continuously obtained. Certainly for many years a comfortable income has been made by farmers in this section of the State of Rhode Island, where prosperous conditions are evident.

South Shore, Massachusetts, U.S.A.—As a confirmation of what is stated in Chapter II. as to development of district poultry industries, may be mentioned the production of winter fowls to the south of Boston Bay, in the United States, where, within the area of a few miles, scores of thousands of these fowls are reared and marketed annually. Some phases of this branch of poultry husbandry are further treated in Chapter XVII., which should be referred to. My present purpose is to show the method adopted, which is specially suited to small holdings, provided that, in order to secure a regular and sufficient supply, a number of occupiers shall operate on the same lines, together with co-operation in marketing. Isolated attempts are of little use. In the district named the farms vary from 40 acres upwards. The plan adopted is to keep a stock of breeders for producing the eggs required for hatching. These are frequently scattered about the farm, though in some instances long-range houses have been built, which I regard as less desirable, for in that case enclosed runs have to be attached. From these the chickens are bred. After the latter are through the earlier stages, the birds are thickly placed on the land in scattered colony houses, each holding fifty birds, but given free range. On one farm of 40 acres which I visited, 6,000 birds had that year been reared and marketed. The houses used were 7 by 6 feet, with open or netted fronts, and well built, yet easily removed as required. About 10 acres were in use for this purpose. As the rearing season extends over seven months out of the twelve, as soon as that period was over the land was ploughed up and planted with rye grass to sweeten and thus utilize the manure. Even with that precaution, in some cases, as might be expected from what has been stated previously, it has been evident that too many birds were being reared, for since the time of my visit less satisfactory results have been obtained, not only due to actual disease, but to lessened fertility of eggs and increased mortality of chickens.

This is an experience by no means peculiar, so long as the due relationship of animal to plant life is not maintained. It is not the success achieved in the first two or three years which determines this question, but when accumulation of unexhausted manurial influences makes itself manifest. South Shore roasters, as they are called, are in many cases capons, and have not only an abundance but a fine quality of soft flesh. The system has sufficiently proved its practicality and profitability. It must, however, be applied in accordance with the rotation principles laid down previously. In Chapter XVII. will be found particulars of a method which promises to be very valuable for similar purposes, though on different lines.

Chicken Production.—Mention has already been made of the influence exerted upon prices obtained for lean chickens where

PLATE II.

A South Shore Roaster Farm, Mass., U.S.A.

fattening establishments are within reach. Under those conditions, provided the land is suitable and the necessary attention can be given, there is no more profitable work for the small, and even the allotment, holder, than the keeping of breeding stock of a suitable class, hatching eggs laid by them, and rearing the chickens to about three months old, when they are sold to the fatteners. That is the system adopted so largely in the south-eastern counties of England. In this way the parent flock need not be large, and, as the youngsters are speedily got rid of, there are few risks of having too many. To a more limited degree the same plan has been introduced in a few Irish counties, as in Belgium, though in the last-named the temptation has been to unduly increase numbers and rear on intensive lines, which have led to loss of vigour in the birds. What may be termed the Sussex method is to rear under more or less natural conditions, even though a considerable number may be raised every season.

A South Country saying is that "a good laying hen is more profitable than a breeding ewe." What is meant is that the hen through her progeny will return more money than the sheep, considering the land she requires. As an example, upon a farm in West Kent I found fifty breeding hens, from which the chickens hatched in one season for sale to collectors had realized £87. That works out at practically 35s. per hen, which would be a good average for a sheep. This is, of course, a gross amount. But when food and labour were reckoned the margin of profit was satisfactory. Such could not have been arrived at unless the demand was constant and prices good, as is always the case in fattening areas. Under similar conditions this branch can be strongly commended to small holders in such localities. The methods adopted should be conducive to early laying and hatching, for it is desirable to have the first chickens ready for sale as soon after the new year as possible, with a succession on to June or July. As fattening establishments increase in number, and are more widely distributed, opportunities in the direction indicated will increase. Properly managed there is no reason why an annual return of £2 per acre should not be realized in this manner as an addition to the general work of the farm.

Sale of Duck Eggs.—Duck-raising, where the conditions as to soil and water are favourable, is within the scope of small and allotment holders. Information as to methods is given in Chapter XVIII. My immediate purpose, however, is to show that where there are duck breeders a demand exists for eggs for hatching at good prices from October to March. This branch of poultry husbandry is usually divided into two sections, by reason of the fact that those who undertake the work of hatching and rearing find it more conducive to a regular supply of eggs, and it is more profitable to buy eggs than to keep the stock birds, due to the fact that, as the latter require to be at liberty, in order to obtain eggs high in fertility and vigour of germs, small holders are not often in a position to provide the most favoured conditions. As I show in the chapter referred to, that is not the method adopted on the great American duck plants. We have, however, to regard our special conditions, under which the adoption of the dual system is to be preferred.

Where the land is gravel or porous in its nature, and streams of water traverse it, affords the most favourable opportunity for production of ducks. Therefore occupiers living in valleys or on flat lands frequently have the conditions which should be taken advantage of. It is upon these that the finest ducklings are produced, whether at home or abroad. Water is the natural element of this species of poultry. The birds may either be given full liberty, except that they should have enclosed yards, and not be allowed out until after, say, 10 a.m. during the period of laying, by which hour they will have laid, or they may be kept within large enclosures of which a running stream or a pond forms a considerable portion. The main point is early hatching, so that the young ducks may begin to lay in the autumn, for older birds do not become productive until the season is more advanced. The last-named should be alone used for breeding the stock birds.

Allotments. — When we come to smaller occupations such as can be designated allotments, it may be accepted that these are unable to afford an adequate living, except the standard of life is a very low one. Therefore they form a subsidiary pursuit, supplemental to some other source of income. It is, however, of very great importance that, in the interest of individuals and the community at large, every encouragement should be given in this direction. It is imperative to promote the prosperity of the humbler sections of our rural population in this way. As an example, I came across a man some years ago, in a southern county, who told me that the previous year he had made a profit of £7 by his poultry. That seems a small sum. As his weekly wage was not more than 12s., it meant an addition of nearly 25 per cent. to his income, which was a substantial increase. A further point is that, as the allotment holder supplies his family with vegetables, it is a great gain, more especially for the children, if he is able to provide them with eggs and an occasional fowl, neither of which his wife would or could afford to buy. Further, by a regular system of rotation he can greatly advance the fertility of his land for cropping by manure from the fowls. Where a mistake is often made, however, is in thinking that a living can be made by poultry on 2 or 3 acres. The overturn can never be enough to do that. What explains many failures is overcrowding—that is, attempting and expecting too much without maintaining the relationship between stock and cultivation. It is the latter which makes the former possible.

Division of the Land.—Except upon larger allotments—that is, such as approach the 5-acre dividing line from small holdings, in which case what has been stated in the earlier paragraphs of the present chapter will apply—it is generally found necessary to divide up the land for its full utilization, otherwise the fowls will do a considerable amount of damage to growing crops. Under such circumstances the use of wire netting is unavoidable. Unless there are to be maintained breeding-pens of pure races which must be kept separate, I do not suggest division of the land into runs. Such methods are not desirable for the allotment holder, who will at most require two such divisions, first for the general flock of layers, and second to be used for a pen of breeders early in the year, and for growing chickens, if these cannot be given liberty, later on. When the chicks are young they can be kept in coops and runs on one of the ordinary fields or plots. Wire netting is alone required to prevent the fowls straying at undesirable times on to the cultivated areas. There is, I believe, a large amount of misconception as to the damage wrought by fowls among growing crops. At the same time the risk is considerably greater where the holding or allotment is small than on larger farms, as *pro rata* to the acreage the number of poultry will be greater. An application of the colony method is, therefore, desirable under such circumstances.

Poultry Allotments.—Much can be accomplished by systematic management on small areas of land. They might be reduplicated on similar allotments or gardens all over the country. Where there is more land available the methods as recommended for small holdings can be adopted. The principle, however, should be the same. In the latter the four-course rotation is to be preferred—that is, three years' cultivation and one year poultry. What I now wish to deal with are sometimes termed poultry allotments—that is, where land is taken expressly for poultry. In that connection an essential necessity is provision for changing the runs. Many attempts have failed due to neglect in this direction, one instance of which will suffice. I was invited by a lady in the North of England to see some poultry allotments on her estate recently provided for the labourers. Splendid houses had been built, substantial fences erected to the runs, each one-eighth of an acre in extent, and the location was excellent as well as very convienent. There were some dozen of these allotments, forming quite a model plant in appearance. No provision, however, had been made for changing the ground. I informed the well-meaning owner, as the houses were too heavy to remove except at great cost, that in two or three years the ground must become tainted, unless it were dug up and each run again divided so as to utilize the manure. Many other cases could be cited in the same way. Poultry allotments without cultivation can have only one end. Yet they may be made successful if designed on right lines.

Burnley and its Allotments.—In no part of Britain have greater developments taken place than at Burnley, Lancashire, where for some years the Northern Utility Poultry Club has conducted laying competitions. That thriving manufacturing town is a hotbed of poultry enthusiasts, who have done wonders in spite of many difficulties, and the having to pay a very high rental for land, sometimes as much as £10 per acre, not by reason of productiveness, but from its proximity to the town. The soot-coated soil does not at first sight appear good for fowls, though upon that subject knowledge is superficial. By careful management success has been achieved. The methods adopted are ingenious in the extreme, utilizing the land to the fullest extent. When it is stated that upon one such allotment of half an acre as many as 500 birds, old and young, have been kept at one time, and that 34,500 eggs were produced in twelve months, it is evident the system is on intensive lines. It should be stated that a considerable portion of the space is occupied with scratching sheds, and that in many cases the runs are partly covered with fine ashes. In the former the manure does not foul the ground, and, as the ashes are removed from time to time, the risk of earth taint is reduced to a minimum. Consequently, what is done here would be impossible unless the system were rigidly applied, and detail carefully attended to. To some extent a certain amount of cultivation takes place, and many of the men are skilled gardeners. At the same time it is found that after a few years a rest must be given to the land, even with all the precautions that may be taken, as evidenced by lesser success than in the earlier years of occupation, and by a weakening of the stock continuously bred and kept under these conditions. The best method would be to remove to fresh ground, but that is difficult by reason of the nature of the houses and fences, if even land were obtainable, which is not always the case. Later developments have been in the direction of larger areas, which is all to the good. My own impression has been that if less were attempted with fowls, and more in cultivation, the ultimate gain would be greater. Such a system might be used to a much larger extent under similar conditions in many districts than is now the case—that is, in the neighbourhood of industrial centres—and would greatly increase home production of eggs, for it is useless in other branches. It must, however, be conducted in a manner to reduce the risks of manure-charged earth, which is the *bête noire* of poultry allotments. What is met with at Burnley is also found throughout the manufacturing districts of East Lancashire and the West Riding of Yorkshire.

Renaix, Belgium.—Parts of West Belgium in many respects have similar conditions to those referred to in the previous paragraph. Renaix is a town of 22,000 inhabitants, and many of the artisans keep poultry on industrial lines, not merely for supply of their own households, but for sale of the produce, and as a supplemental pursuit, which always is the case. These people live in the suburbs of the town, where they are able to rent a hectare (2½ acres) of good land at 120 francs (£4 16s.) per annum, or, inclusive of a small dwelling-house, at 200 francs (£18) yearly. Under these conditions there is not the same intensification, nor are as many birds kept, whilst the land is cropped or eaten off by other stock. Many of these operatives are from farmer families, and understand methods of cultivation. As a rule forty to fifty hens would be kept upon each of these holdings, and not more. The reverse is often true with our people, who think of poultry and nothing else. They do not realize that animal life cannot exist by itself.

CHAPTER IX

BREEDING PLANTS AND FARMS

Grossly abused has been the term "poultry farm," the meaning of which is generally misunderstood. It has been recklessly applied to all sorts of places, from backyards to big concerns. In one instance letters to the Press and printed notepaper gave the impression of a farm of considerable size. Yet it was comprised within a small village garden, and the birds on it had not reached half a score. We should not despise the day of small things, rather the reverse, for it is by evolution from the lesser that we are most likely to reach the greater. Designations also are often an inspiration. They should, however, be retained for personal contemplation until something has been achieved, until, in fact, there is a measure of relationship between actuality and terms which are applied. It would be as fitting for a cottager to call his place a "fruit farm" because he has half a score trees and bushes, as call "poultry farms" some of the plants advertised. There can be no doubt that poultry husbandry has suffered much at the hands of its friends. Even more serious, however, is the misinterpretation of the term. Generally speaking it is thought that the so-called poultry farms are chiefly concerned with the production of eggs and chickens for human consumption, whereas the fact is that in this direction they have a very limited influence. Probably 99 per cent. of the establishments, large and small, to which this name is given should be called "poultry-breeding plants," and to them the word "farm" is totally unsuitable. Many combine exhibiting with other operations, such prizes as may be won acting as a means of advertisement to secure customers.

Influence of Breeding Farms.—In Chapter II. reference will be found to the place of such establishments in relation to poultry husbandry. As there stated, I regard them as essential to development, and that *pari passu* with increase of poultry upon farms, small holdings, allotments, and elsewhere, so will the need for these correspondingly advance. They have, therefore, an important function in promoting progression of the industry as a whole, and in fuller realization of the national food resources. Formerly farmers and others when purchasing fresh stock obtained birds or eggs for hatching from fanciers or exhibitors, who thus found a profitable outlet for their surplus birds and eggs. Thanks, however, to the undue exaltation of abnormal characters and disregard of economic qualities in exhibition stock, the results are often unsatisfactory. As stated by Professor Eugene Davenport, " when our standards are decidedly against the highest fertility they are dangerous, if not fatal, to the race"; and the samea pplies to productiveness of eggs or flesh and to constitutional vigour. As a result there have come into being a large number of poultry-breeding plants, some on a large scale, where birds can be obtained which, whilst retaining the racial characteristics, are chiefly bred for their productive qualities. These have largely captured the trade once entirely in the hands of fanciers. In this direction there are greater possibilities as yet untouched. As a further fact, the specialist poultryman must take up this branch if he is to succeed. In brief, the so-called great poultry farms at home and abroad depend for their success upon the sale of stock birds, etc. That this branch requires considerable training and a high standard of qualifications may be accepted. Such are, however, within the powers of many if they have the resources and determination required.

Mainly Supplemental.—There are a few examples of farmers who have taken up this work, as in other branches of domesticated animals, and who specialize in production of breeding stock, etc. No reason can be adduced why the number should not be largely increased. They have the decided advantage of ability to give their birds plenty of range, and to rear the chickens under the most favourable conditions. The business, however, requires steady and persistent attention, involving a considerable amount of correspondence and intelligent anticipation, as well as careful study of breeds. As a rule specialist establishments are run on poultry lines, and everything else is supplemental. When that is so, a risk is ever present of attempting more than the amount of land available warrants. Some of the most successful poultry-breeding farms prove that this can be avoided, where the principles laid down as to the relationships of animal and plant life are observed. In several such cases at which the operations are on a sufficiently large scale, not only has a good living been made, but a competency secured. I am convinced that on the more open areas many farms of this class could be established successfully, even though not so accessible as might otherwise be desired.

As a rule, however, the great majority of breeding plants are operated upon a smaller scale, and are not regarded as a means of living, but as a supplemental source of income. If advertisements in the newspapers or other publications are studied, it will be evident that this is true. In many respects that is preferable, though not in all. The risk is that a large number of these breeders are compelled to keep their birds in small runs, as a result of which the progeny are less vigorous than would otherwise be the case. Introduction of the scratching-shed system and better knowledge of feeding have done something to counteract these influences, though nothing can take the place of a better environment. Many small breeders look forward to the time when they can enlarge their borders, but have wisely commenced on a moderate scale. My own view is that we owe more than is generally acknowledged to this class of breeder, who, with all his limitations, has done much to meet a demand for better-class poultry.

Small and Large Plants.—There are two ways of carrying on a breeding poultry farm: First, by concentration entirely upon sale of stock, eggs for hatching, etc., in which case all surplus birds other than those required in the breeding-pens, or that may be regarded as saleable, are sold off, so that at the commencement of each new year the number of adult poultry will be at its minimum. This is the plan recommended to those whose land is limited. To attempt more than that is frequently to lose all. Under such conditions it is imperative that the runs shall be given as much rest as possible, or be heavily cropped. And, second, by combination of egg production in larger flocks of unmated hens, and having as many selected breeding-pens, to supply eggs for hatching either at home or for sale, as can be maintained. Upon farms of fair size where carried out successfully the advantages are that there is usually much wider choice of birds for breeders, as the total number is large, and that the yearling hens can be kept on range during their first year, when the eggs laid by them should more than pay the food cost. Attention is called in Chapter IV. to the importance of not using birds in their first year as breeders. On smaller plants one of the main difficulties is to keep the pullets until the second year. The temptation is to mate them up at the earlier period, even where the undesirability of so doing is recognized. An excellent plan is to send the pullets out to a farm for the first year. That would pay both parties to the arrangement if fairly carried out. The drawback is that there cannot be the testing necessary to prove which are the more prolific layers, which is important in the egg-producing breeds.

Equipment.—Upon larger breeding farms what has been fully described in the two previous chapters may be adopted—that is, distribution over the land, with perhaps a few enclosed yards for specially selected breeders. Such is not absolutely necessary, as breeding-pens on range will not usually mix. In that case portable houses are commended. As a question of economizing labour, the plan frequently adopted is to have all the pens within restricted areas, more especially if several breeds are kept, as the risks of mixing are thus thought to be minimized. Provided that as chickens and during the first year the birds have had free range, this arrangement answers admirably. The mistake generally made, however, is in having the runs too small. Long-range houses divided into compartments tend in this direction, as does the desire to economize space and fencing. On some of the best breeding poultry farms with which I am acquainted quarter-acre plots are used, which are quite small enough for a cock and ten hens—that is, if to be used continuously year after year. Even under such conditions, when the breeding season is over it is desirable to remove the inmates, and either feed off the grass by sheep or cut for hay, or, if arable, plough and plant with a quick-growing crop. Such a run is ample for the number of birds stated above. If planted with bush or other fruit there will be a dual return. In these runs a roomy house should be provided. It will be evident, however, that with original cost and maintenance of house and fencing the equipment cannot be less than £1 per inmate per annum, so that this system would not be profitable where market production is the object. As the returns will be considerably higher upon breeding farms, the greater expense may be fully justified. At the same time, where the range system is possible it means reduction of first and annual expenditure. I cannot too strongly emphasize the important part that cultivation of the soil must take in such plants whether large or small. Many have ultimately failed by reason of neglect on this score.

Exhibiting.—On a few of these specialist establishments where the breeding of utility poultry is the leading object, a moderate amount of attention is paid to exhibiting, though that is generally among the more practical races. The main object is to obtain an advertisement for the stock. Showing fowls is seldom profitable for its own sake. Where the fancy side is developed separate strains must be kept, although on farms where large numbers of birds are hatched every year occasionally specimens are produced high in show qualities. At the same time it is often good policy to send a few birds to agricultural or local shows, even though these are almost entirely run on fancy lines.

Class of Stock.—The amateur or exhibitor may choose the breed or breeds he will keep to please himself, whereas the poultryman who caters for a trade in stock, etc., must have the poultry his customers desire and are willing to buy. Therefore it is important that he shall be up to date in his stock. For his purpose, it is useless having the best races in existence if there is an insufficient demand or the prices obtainable are meagre. In this respect changes are constantly taking place. Within my own observation, many breeds have had periods of great popularity, when it was difficult to supply orders. Then came a lull, and afterwards a decline in public favour. No rule can be laid down for such vagaries. It is not a question of productiveness alone, but largely of fashion or novelty. One point, however, must be mentioned—namely, it is often true, when first introduced, that a breed is highly fecund, due doubtless to the change of environment already noted, and that after a time this is not maintained, as a result of which demand falls off. In other cases, when a breed is boomed, its advocates exaggerate its qualities, so that buyers are disappointed. Some breeds have held their position to a remarkable degree by the possession of sterling qualities. Even with these there are times of lessened popularity. After a period of decline they usually regain their position. What, therefore, the breeder must do is to study and even anticipate these changes, selecting his breeds accordingly. On some of the smaller plants it is found better to have only one or two breeds. On larger places many may be kept, in which direction the practical breeder differs from the fancier, who must concentrate if he wishes to succeed. And as higher prices can always be obtained for pure-bred stock, or eggs for hatching and day-old chicks from these, than for cross-breds, the former should be maintained.

Sale of Stock Birds.—Primarily poultry-breeding farms are engaged in the work of supplying fully-grown birds suitable for stock purposes, and in many cases that forms the greater part of the trade done, though in recent days eggs for hatching and day-old chicks, dealt with in later paragraphs, frequently bulk largest in the returns. On even a three-years basis—that is,

PLATE III.

On a Yorkshire Breeding Farm.

the average life of poultry extends over the period stated—upwards of 8,000,000 stock fowls, to say nothing of ducks, geese, and turkeys, have to be bred annually to maintain the existing stock of poultry on farms in the United Kingdom, without provision for any increase whatever. The great majority of these are bred on the places where they are destined to live. At the same time considerable numbers are sold and purchased in one way or another. If we compute that only 1 per cent. of the new flocks coming into profit every year are purchased, which is a very conservative estimate, that would mean a demand for 80,000 birds every year, in addition to which would be the greater extent of sale to amateurs and the smaller grades of poultry-keepers, who are compelled to a frequent introduction of fresh stock by reason of their conditions making to a greater extent for degeneracy than is the case upon farms. From what has been stated, therefore, it is evident that the demand is a very large one, and that as poultry husbandry advances the trade will correspondingly increase. The mistake which is often made by smaller breeders especially is in expecting that they can find a market for their surplus cockerels alone, which are often a drug, by reason of the fact that there are too many of them. Upon the basis of ten females to one male, which is a breeding average, there will be a vastly greater sale for the former than the latter, even when we take into account the fact that many farmers and others breed pullets and buy cocks to mate with them. As a rule the number of cockerels and pullets bred annually are fairly equal in number. Therefore a considerable proportion of the former should be killed off. The number bred should be regulated in accordance with what is here laid down, so that the proportion of pullets may have due relationship to the cockerels likely to be sold.

Values.—At one period the value of a fowl for stock was wholly determined by its purity of race and the degree of perfection in external characters. Whilst both of these have still an appreciable value, another factor has been introduced, more especially in connection with egg-producing breeds—namely, family records in the direction indicated. As a consequence what are called pedigree strains are sold largely, in which the productiveness is indicated. As is usually the case, there has been a strong tendency to place too much reliance upon single year performances of a few hens out of flocks, forgetful of the fact that high fecundity is by no means a new feature, and that what one or half a dozen hens may do in this way is no proof that even their sisters are good layers, or that their progeny will be prolific. At the same time, when we arrive at the stage that for, say, five successive generations a family has proved the possesson of this quality, the value will be much enhanced. Such has not as yet been reached. The much heralded 200-egg strain, though many times announced, breaks down when applied to an entire flock, even in a modest proportion. What has, however, always to be remembered is that externals have a leading place, though not so absolute as formerly. Cross-bred birds for stock purposes, however good these may be in the power to transmit egg or flesh qualities, will never realize much more than half what pure-breds will command. Consequently the latter offer greater returns to breeders. The value of stock is not in any one direction, but lies in purity of race, constitutional vigour, profitable qualities, and age. Breeders who have given the greatest attention in these directions are those who have succeeded to the highest degree, and are able to command the best prices by reason of the fact that they can give value for money. It is true that some classes of the community are able and willing to pay more than others. At the same time there is a measure of equalization between price and value.

Cost of Production.—An essential consideration for specialist poultry breeders is the cost of breeding, hatching, and rearing fowls to what may be termed a marketable age. In the case of birds intended to be sold for stock purposes, that is usually when they are from six to eight months old. After the age named the pullets should pay for their keep by the eggs produced, so that if we take seven months as the average it will help in estimating the cost of rearing, premising, however, that upon general farms, where the birds have abundant opportunities during the growing period of obtaining a considerable part of their food-supplies, the expense will be much less. As, however, breeding farms are usually run on more expensive lines, it is desirable to deal in terms applicable to these. A further point is the number handled in accordance with the expense of labour and equipment, neither of which can here be stated in actual figures.

Experiments conducted upon the College Poultry Farm, Theale, some years ago, showed that chickens could be grown to twelve weeks, inclusive of the egg, oil for incubator and brooder, and food, at a cost of about 9d. each. If to that amount is added interest on capital, deterioration of plant and labour, assuming that operations are conducted on a sufficient scale in respect to number of birds, a fair computation would be 1s. 3d. each bird at twelve weeks old. From that age the food cost should not exceed an average of 1½d. per week, so that at seven months old (thirty weeks) the actual expense will be 3s. 6d., to which must be added the items already named, with risks of losses by death, and weeding out of specimens which early reveal arrested development, or for any other reason are unfitted for the purpose in view. My own estimate, therefore, is that, without allowing any margin of profit, the prime cost of breeding stock sold in this way is 5s. per bird, and if selection is rigid, or the number raised small, it will be higher; that may, however, be regarded as the minimum under the conditions named. The sum named allows nothing for advertising or for other expenditure incurred, though it may not be necessary, nor does it provide for exceptional mortality. On the other hand, the range farmer can probably produce such stock at 1s. to 1s. 6d. each below the amount named.

Prices of Stock Birds.—One of the most difficult questions which the poultry breeder has to determine is the price he shall ask for birds he has to dispose of. Very often this will be decided by what people will pay, rather than the actual value; there is, in fact, no fixed value. I have known cases where vendors have sold birds of the same flock to half a dozen different people at as many prices, simply getting as much as possible within reasonable limits from each. In this connection we must remember that the same bird may be worth much more to one buyer than to another; the vagaries of purchasers are often very puzzling. Even though they never intend to exhibit, yet more money will be given for stock advertised as from a prize strain than from one not so designated, even though the latter may be vastly superior for practical purposes. Moreover, popularity means much; if a breed is being boomed and written up, a demand is created which means enhancement of realizable values, so long as the rage continues. All breeders have experienced instances of this kind. When the Buff Orpington was first introduced, one breeder wrote me that his birds were what had been known as Lincolnshire Buffs, and that the two names represented one race, which was undoubtedly true in the main, but that if he called them by the former term he could get twice as much as was obtainable if dubbed by the older title.

In this respect reputation is of great importance. A well-established breeder who has made his name can always secure better prices than those who are less known; that is so in everything. Some there are who find it more profitable to sell their stock to the bigger men than undertake the direct trade themselves; in fact, there is a great amount of dealing of this nature. Much might be said on that score, but is unnecessary. The final vendor is really a retailer, buying from others in a wholesale fashion. A variation of method is placing out selected birds on farms, and buying in the chickens bred at fixed rates, which is certainly more legitimate, in that the original stock is owned by the vendor.

From what has already been stated, I am unable to see that anyone can sell well-grown typical healthy birds at six to eight months old, even with a very moderate amount of profit, under 6s. 6d. to 7s. 6d. each, and even that will not allow much margin for trouble and risks involved. Such an average might pay the breeder who only regards it as a supplementary pursuit; to the man who expects to make a living out of the business that would not be enough. Many buyers expect to get birds at 4s. or 5s. each, or even less, in which case they must be content with inferior or late-hatched specimens, or such as are produced by ordinary farmers; further, cocks or cockerels are usually 50 per cent. higher in price than females, and rightly so. A female can only influence her own progeny, whereas a male will exert his powers over every hen with which he is mated, and, moreover, he costs more to produce. A further point in this connection is that second-year birds which have not been used for breeding in their first season are more valuable than yearlings, and the male birds especially have cost more to bring to that stage; this fact is seldom recognized by purchasers, who prefer young birds because they are cheaper.

Period of Demand.—The season of greatest sale in this country for stock birds extends from September to February, though there is a demand to a limited extent all the year round. Many of the more systematic breeders aim to have disposed of the bulk of their saleable flocks by Christmas; at the same time they usually have a number of birds beyond their actual requirements, which can be retained if not sold, but are available if demand arises at paying prices. For the simple reason that everyone who takes up this work desires to get rid as soon as possible of such birds as he does not require for breeding, the great majority are so disposed of when six to ten months old; and as the buyers do not purchase until the time is approaching when the stock are to be used, these influences make for a very extensive employment of yearlings. Though it be fully recognized that this is undesirable, I cannot see how it can be avoided; at the same time the question is one of considerable importance, tending to debilitation if the practice be persisted in. What should be done is to impress the importance of retention of good breeders into the second and third years, and make the younger specimens fewer in number than those more fully matured.

Export Trade.—Some of the larger breeders add considerably to their returns by developing business relationships with British colonies and foreign countries, which trade is capable of great increase. In the earlier days it was chiefly in exhibition fowls, for which high prices were paid, as the transit charges are the same on poor as on good specimens, and it appeared to be more economic to purchase the best. Within recent years there has been a growing sale of utility stock; upon that aspect of the question it is unnecessary to dwell, as the business is restricted to a few breeders. Special packages have to be provided, giving the birds sufficient space and enabling them to be fed *en route*. The appliance firms supply such boxes or coops as have proved useful for sea-voyages, and the companies engaged in shipping quote terms for delivery almost anywhere. Attention to the fowls on the voyage is secured by a payment to the cook or butcher on board for every bird he lands in good condition at the end of the journey. Those forwarded to the nearer European countries are usually sent in poultry hampers. One fact to be kept in view in shipping south of the Equator is that the breeding seasons are opposite to those north of the Line; therefore it is desirable to allow the birds to develop more fully than is usually the case with those sold at home.

To succeed in this business, the special points are to never sell a bird which would not be good enough for breeding at home, to take the same care in selection for type and constitutional vigour as if it was to be used by the breeder, and always to ship in good condition; the last-named is essential in order that the recipient may be satisfied.

Eggs for Hatching.—Many poultry-keepers renew their stock by the purchase of a few sittings of eggs every year, in place of, or additional to, hatching such as are laid by their own birds. The trade done is an enormous one, as evidenced by the number of advertisements in the poultry and general papers; some of the larger breeding farms dispose of hundreds or even thousands of sittings of eggs every season. At the same time those who operate on a smaller scale derive a considerable part of their returns from this trade. It is not too much to state that hitherto a considerable proportion of what are commonly called poultry farms could not have existed at all but for the business obtained in this way. That the system has contributed greatly to development of poultry husbandry is unquestionable, equally in finding a profitable outlet for surplus eggs beyond those required for hatching on the place of origin, at very much higher prices than these would realize in ordinary markets, and that purchasers are able to obtain fresh stock at much lower rates than would be the case if breeding birds were purchased. As a rule the price of a sitting of eggs is about the same as, or even less than, would have to be paid for a single bird, and from such sitting six or eight chickens may be secured. In the case of small poultry-keepers who are compelled to keep their fowls in strict confinement, the plan is often adopted of keeping no male, and rearing a batch of chicks annually from purchased eggs, so that the virility of the flock is well maintained.

As mentioned, however, in Chapter II., there have been many complaints on the part of both vendors and purchasers, sometimes not without good reason. The system lends itself to trickery where there is a disposition to such practices; further, seasons have much to answer for in this direction. It may be generally admitted that travelled eggs do not give the same standard of hatchability as if they are incubated on the place where produced, owing to their delicate mechanism. Transit means liability to shocks and rough treatment, which frequently cause rupture of the contents of the egg, without any damage to the shell; that is especially the case with eggs from highly-bred stock or those kept within small enclosed yards. The trade is one, however carefully conducted, that renders the seller liable to many complaints, and I have known cases where it was entirely given up for this reason. Customers are often unreasonable; they buy eggs and expect chickens. All that can be promised by the vendor is that the same care will be exercised as if the eggs were to be hatched by the breeder himself. He cannot be sure, when he sets a batch of eggs, that a good percentage of chicks will make their appearance; therefore, in selling eggs for hatching, he transfers to his customer for a money payment the chances, such as they are. At the same time it is his business to see that the buyer has a fair opportunity of obtaining what has been paid for. In order to afford a fair guarantee, the practice has been adopted of replacing infertile eggs, which is fair to both parties. The buyer has no chance of a chicken unless the egg is fertilized; if it contains a living germ the responsibility is, and should be, that of the purchaser, for non-hatching is outside the control of the original breeder, and may be due to bad management of the buyer or to the hen under or the incubator in which they are placed. Fair and generous treatment, however, pays in the long-run.

Production of Eggs for Hatching.—What has been stated in preceding paragraphs with respect to the trade in stock birds applies also in this case—that is, as to arrangements for breeding. Anyone who takes up this trade must be in a position to supply eggs for hatching at the time they are in demand, which, except for special purposes, usually extends from February to the end of May. March and April are the chief period of sale. To do this needs prevision; it is useless being too late. In order to meet the demand it is customary to have several pens, pullets in some to meet the earlier and hens for the later demand. On a well-managed plant all the birds, even two and three year old hens, should be in profit by the first of February, in which case the older birds may be chiefly depended upon. A great amount of harm is being done by sending out eggs for hatching from and day-old chicks from eggs laid by immature stock, for that tends to enfeeblement of the progeny.

One very important point is that the birds which produce the eggs shall be kept under conditions that conduce to constitutional vigour. On range is the most desirable; such, however, is not always possible. Where enclosed in runs, these should be sufficiently large, and by provision of scratching-shed accommodation induce as much exercise as possible; further, it is desirable not to put the hens in runs until near the time their eggs will be required. What must be secured is that the eggs sold shall be of the breed as represented; a purchaser who orders White Leghorns does not want Orpingtons. It is here where a great amount of trouble arises when breeding-pens are placed out on farms, as is often the case, for the control is not thus in the hands of the vendor, and he may have eggs sent to him which are other than they are represented to be. When the parties concerned are reliable, that plan is to be commended, for under such circumstances the breeding stock are usually on range.

Selection and Packing.—I have already explained that every bird bred is not fitted for reproductive purposes, and that only those should be chosen for this work which are selected specimens; in the same way, every egg laid is not necessarily suitable for hatching purposes, even when strongly fertilized. More information upon this question is given in Chapter XV., which may be referred to. Those who sell eggs for hatching should select such as are sent away in the same manner as they would for incubation at home; nothing conduces to loss of confidence so much as the receiving of a lot of undersized, misshapen, or weak-shelled eggs.

Very important is the question of package. Frequently sellers of cheap eggs despatch in ordinary grocers' boxes, using hay or even sawdust as packing material. If deep enough and the eggs are unable to move, these may answer the purpose, provided that the boxes are handled carefully; that, however, cannot be assured, and the risks are considerably increased. Boxes are always liable to jars and shocks, and there is no spring in them to minimize the concussion. As an Irishman is reputed to have said, it is not the fall that hurts, but the sudden stop. Special egg boxes are sold by appliance-makers, may of which are excellent. In some of these corrugated paper is used between the eggs, and felting above and below. A very excellent form of case is made entirely of cardboard, with a section for each egg, and, as the package is yielding, it generally carries the contents safely. The main thing is to have a cushion, so that if the package falls the force will be reduced to a minimum. The best way of sending eggs that I know is in roomy baskets, though this method entails more trouble; it is, however, worth the labour. At bottom should be placed a layer of soft hay; then each egg is wrapped in hay and so bedded that all are firm. Hay between the rows and a cushion on top will, when the lid is tied down, make a springy package that will carry from one end of the country to another in perfect safety and yield the best results. Such a system may be used for large or small numbers. In cold weather it is desirable to wrap each egg in a piece of paper as a protection. Where boxes are used, these should, for obvious reasons, never be nailed down. Whatever the package, it should be labelled boldly "Eggs for Hatching," which usually commands better treatment *en route*. Experience has shown that it is better to forward such eggs by rail, and not by parcels post.

So far as prices are concerned, these vary in accordance with the value of the stock, popularity of a breed, and class of buyers, as well as season when sold and the number bought.

Day-Old Chicks.—This business has assumed within the last few years considerable dimensions, and is capable of great developments in the future, provided that those who undertake it do justice both to themselves and their customers. Breeding from immature and enfeebled stock, forced to secure early laying or kept under bad conditions, ought to be strenuously avoided. The prime necessity is not alone to secure hatchability of eggs, but that the chickens shall be vigorous. What may be termed a hatchery can be set up anywhere, if the place is suitable; that is not, however, the prime question, but whence eggs are obtainable. Some of the most successful businesses in this direction are upon farms where land is cheap and the stock birds have free range; those conditions afford the greatest opportunities of success, as the chicks are hatched with a great reserve of natural strength. These supply mainly, if not entirely, the eggs required. To do that a large stock must be kept, because the eggs are useless for this purpose if not produced between January and May. On one of these farms with which I am acquainted 30,000 chicks are sold annually, but on another as many as 80,000 have been hatched in a single season. To obtain such numbers the eggs available must be nearly double those stated; thus, to have enough eggs to run the former establishment 600 to 1,000 hens must be available, according to their prolificacy. A considerable number of establishments have sprung up for which all eggs are purchased. If organization of supplies is upon a reliable and adequate scale, obtaining eggs alone from farmers who can be trusted and who keep their birds on range, these can also be conducted successfully, even though there are greater risks and losses from use of travelled eggs than if produced by hens on the spot; such is, however, better than keeping hens in close runs, as is too often the case.

Plant for Day-Old Chicks.—Many years ago in the Birmingham district I came across a custom of selling hens with their broods, in which direction a considerable trade was done from the first of May onwards. In this manner breeders found a market for their older hens. Such a system, however, has its limitations, as it is entirely dependent upon the supply of broody hens. It is the successful operation of incubators that has afforded an opportunity for development of the trade, which has grown so largely, of selling chicks when a day old; in fact, there is no other way of conducting such an enterprise, equally as to cost of production and enabling chicks to be hatched early enough and continuously during the season in order to meet the demand. Apart, therefore, from what may be termed the breeding plant, or organization for adequate supply of the right class of eggs, there must be incubator capacity correlative to the trade to be done. Particulars of such equipment are given in Chapter XV. It is enough for the present purpose to state that, as the main period of demand extends from February to June, the maximum season being March, April, and the earlier half of May, provision must be made accordingly. That means, so far as chickens are concerned, all the work is concentrated within twenty weeks, so that, practically speaking, each incubator, allowing for three or four days' interval between hatching, may be operated five times within a season. In the case of ducklings, which take a week longer, we can only reckon on four hatches. With regard to the former, as it is found that, roughly speaking and allowing for infertile eggs, death in shell, accidents, and malformed chickens, two eggs will be required for every liveable chick produced, it will be seen that the incubator capacity must be 400 eggs for every 1,000 chickens hatched—that is, provided the machines are used continuously during the months named. Thus, if 5,000, chicks are sold in one year, incubators must be available holding at one time 2,000 eggs, and so on. In the case of ducklings, which trade has been touched to a very limited extent and is capable of great development, the incubator capacity would need to be increased by 25 per cent.; for this trade, therefore, the equipment for hatching must be relative to the eggs to be incubated and the chickens produced.

Cost of Producing Day-Old Chicks.—The actual cost involved in production of chickens can to some extent be approximated. So far as eggs are concerned, that will depend upon many factors, inclusive of the fecundity of hens themselves. Fortunately, the period of the year for this trade is when market eggs are at their minimum of price, although even for that purpose in February the values are greater than in March and in April. Where stock birds are kept which have been carefully selected, and to which special attention is given, the eggs produced by them are worth more than those from ordinary fowls at free range upon farms; that fact has, therefore, to be taken into consideration. A further point is whether such eggs can be sold for hatching purposes and at what prices. For instance, if a breeder has a demand for eggs at, say, 5s. per dozen, and he decides instead to hatch and sell the chicks produced, he would naturally expect a higher return than if the eggs were from ordinary stock. Unless such advanced price is obtainable he will be a loser, apart from the greater risks and labour involved, and that a much larger capital expenditure is required for equipment of a hatchery than on a breeding farm whence eggs are sold for hatching.

So far as what may be termed establishment expenses are concerned, where operations are conducted on a fairly large scale, my calculation is that the actual cost, apart from the eggs, works out at not less than 1s. 6d. per dozen chicks; this allows for labour, assuming that it is skilled and fully employed, interest on capital, depreciation of plant, cost of running machines and boxes in which the chicks when hatched are despatched. On the College Poultry Farm, Theale, we found that the expense of oil to run incubators was 0·21d. per chick hatched, which is 2½d. per dozen. The other items are variable, more especially labour. For example, one man can comfortably manage the hatching, packing, and despatch, of a thousand chicks per week. If he only turned out half that number, and did nothing else, the cost of his labour *pro rata* would be doubled.

What we have now to take into consideration is the egg cost or egg values. On the basis of two eggs to one chicken, it will be seen that day-old chicks at hatching cost as follows:

Egg Values.	Egg Cost.	General Cost.	Total Cost.
	s. d.	s. d.	s. d.
Eggs at 1d. each	2 0	1 6	3 6 per dozen
,, 1½d. ,, ...	3 0	1 6	4 6 ,,
,, 2d. ,, ...	4 0	1 6	5 6 ,,
,, 3d. ,, ...	6 0	1 6	7 6 ,,

With eggs of higher values the prime cost will be correspondingly greater; therefore, for chicks of ordinary stock 5s. to 6s. per dozen, and from more carefully selected birds 7s. 6d. to 15s. per dozen, are, considering the risks, reasonable rates in view of the fact that actual chicks are delivered. Where the quantities purchased are large, reductions may be made, but the vendor must have a living profit; also, early chicks are more expensive to produce than those sold later.

Chick Boxes.—In order that the birds shall be able to bear the journey, it is essential that they be bred from vigorous stock. Further, some breeds stand transit better than do others ; that, however, will be learnt by experience. The question is, when the chickens should be delivered. The result of long experience has shown that when they are properly dried, and have recovered from the strain of hatching, which will be in about twenty-four hours after emergence from the shell, is the best time to send them away. They should be packed in good wooden or cardboard boxes; these need not be large, as for a dozen chickens a box about 14 by 9 inches is quite spacious enough; for two dozen the box may be 15 inches square. Not more than two dozen should be sent in a box unless divided. The box should have 9 inches

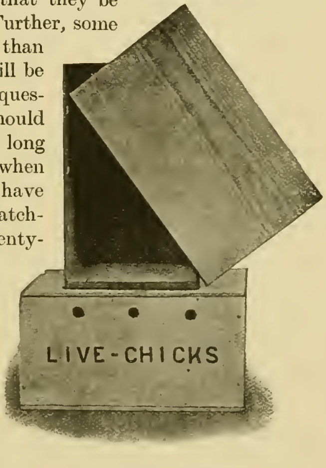


Fig. 6.—Day-Old Chick Boxes.

of head room, and be plentifully supplied with ventilation holes above the heads of the chickens. A piece of fine sacking or flannel or calico should be made a cover, on which some loose hay can be placed, above which is a wooden lid. The inside should be well littered out with cut chaff, and to provide the chickens with food, if the journey is a long one, in the cut chaff there should be scattered some canary-seed, dari, and hemp-seed. The chicks will scratch about for it if the place is fairly light, and thus keep themselves warm, as well as obtain the necessary support. Two or three bunches of greenstuff, such as lettuce or young cabbage, should be suspended inside the box, if the journey is a very long one, as the chickens will eat this very readily. Chickens so packed, even when despatched at the early age named, have been known to travel hundreds of miles without loss. What is necessary, however, is to consider the time of year. We should deprecate the sending of young chickens in this way during very severe frosts, especially if they had to make a cross-country journey where there would be danger of exposure at railway-stations. The boxes should be well made, and if the weather is unfavourable a piece of sacking nailed on the outside would add considerably to the warmth within. The box should be well labelled, and have on top: "Live Chickens. This Side Up. With Care." A cord across the top for a handle will facilitate moving and insure safety.

Weaned Chickens.—A demand has arisen to some extent for chickens when they leave the brooders, though it has not developed so rapidly as the trade in day-old chickens, perhaps because it has not been pushed to the same extent. I cannot but think that there are great possibilities in this trade, and that if put on a sure basis it would grow to very large dimensions. The advantages to the purchaser would be very great, in that he would receive birds the vigour and virility of which had been proved, and, further, that he would buy in accordance with the sex as well as the age. It is impossible to tell the sex of day-olds, but at six to eight weeks, the time when birds would be sold, this would be discernible. So far as the producer is concerned, such an arrangement would add to the cost of his equipment and labour, as he would require land for rearing, brooders, etc., but that should be compensated by the higher price obtainable, which, to be profitable, must be 50 to 75 per cent. above the day-old price, in some cases more. He would retain the cockerels, for customers would usually want pullets, sell these as milk chickens, or feed and fatten them off.

Pupils.—It is frequently said that many poultry farms exist on the fees of pupils rather than the sale of what may be produced upon the place. That there is a certain amount of justification for thiss tatement is unquestionable. The number of advertisements for pupils is surprising, some of which have little to offer either in the shape of theoretical teaching or practical experience. Fortunately, as a rule these plants are as good as many of those who go to them can appreciate; it is merely a fill-up in their useless lives. We do not want decadents, who have tried everything else and failed, to turn to poultry as a last resort; should they do so, it is better their time be spent where they can do the least harm. Where the farm, whatever the branch undertaken, is well managed, well equipped, and on an adequate scale, there is something to learn, and the earnest student will find the time spent there of the greatest value, especially if operations are on a more extensive scale than is general, for that gives breadth of outlook and experience. Not alone are the fees a gain to the owner of the farm, but the labour thus secured reduces the cost of that item, though not to the extent generally supposed, for a pupil requires very careful supervision at the first; one act of carelessness may involve greater loss than his fees will pay in a twelve-month.

CHAPTER X

INTENSIVE AND SEMI-INTENSIVE POULTRY HUSBANDRY

What are known as intensive methods of poultry-keeping demand consideration, from the fact that these are being heralded as novel, and that many people are led to adopt a system which is yet in the experimental stage—that is, upon a commercial scale—the ultimate form of which, even if it should prove successful, has not been determined. That from all the efforts which are being put forth some good will result, I cannot doubt. Before we arrive at that point experience of a costly kind will have to be accumulated, and much that is now set forth with unlimited assurance and all sincerity will be revised again and yet again. Many plans which are now believed to be perfect will be abandoned. What have to be learnt with respect to every phase of poultry husbandry are the limitations, too often ignored, and the theories built upon inadequate knowledge and experience. One important fact is apparently forgotten — namely, that intensive methods are by no means new, but have been adopted by small poultry-keepers for many years. Further, these differ in an essential factor from such as are described in Chapter VIII., under the head of Allotments. In the latter cultivation of the land is an integral part of the scheme of work, whereas in the more intensive operations that does not enter at all; it is essential, therefore, that this fact be recognized at the outset.

Meaning of Terms.—It is desirable at this stage to indicate the true meaning of the terms which are employed in this connection —namely, intensive and semi-intensive—for these are frequently employed incorrectly. Commonly the word used refers to increase of degree—the raising of whatever is indicated to a higher pitch. As applied to production it means enhanced development within any given environment; therefore, in all cultivation and stock breeding, there must be intensification, as compared with what are termed natural methods, otherwise the world's population could not be provided for. As a matter of fact, all domestication is necessarily intensive; to that extent modern methods of poultry husbandry, even upon farms, might be so designated.

The terms used, however, do not apply to poultry-keeping upon ordinary farms, small holdings, allotments, or breeding plants, but refer to conditions under which poultry are kept where certain of the elemental natural factors are absent altogether or reduced almost to vanishing-point, with a view of enhancing productiveness of eggs or flesh. Nearly all fancy poultry-breeding is more or less intensive; in that case, however, the number of birds kept on a given space or bred is usually smaller, and profit depends upon the less economic factors, consequently the risks are minimized. Where success depends upon the relative degree of marketable products, it is the volume that counts in the main; and whether the produce be vegetables or hens, the tendency is to a much increased quantity of plants or birds on a given space. With these facts in mind I attempt to explain the accepted meanings of the two terms given above, premising that intensification in cultivation can alone be attained by regular replacement in the soil of the elements upon which plants live and grow, and that so far as poultry are concerned the manurial elements must be removed before these exert their influence. In the latter it is an application of what is known as the "soiling system," as in the case of cattle.

The intensive method of poultry husbandry is where the fowls are kept either entirely in houses or within very small enclosures, the number in either case being relatively large to the ground occupied. It is the last-named which determines the degree of intensification, not whether there be six or six hundred under one roof.

In semi-intensive methods we find an attempt to combine what has been stated above with a moderate amount of run. Under such conditions the birds are usually in large flocks, for each of which is provided an extensive scratching-shed house, to which is attached an outside run or runs. As the fowls are fed entirely under cover, and mainly in litter, a considerable part of the manure produced by them is capable of removal, and the quantity falling upon the ground is minimized to that extent. The runs provide an amount of exercise beyond what is obtainable when the hens are scratching among the litter.

"Bird-Cage" Methods.—The small urban or suburban poultry-keeper has no choice whatever. His conditions are such that he must enclose the fowls within small areas, and by expenditure of labour, by adoption of methods which would not be profitable on a commercial basis, and by extreme care in feeding, reduce the effects which would otherwise accrue. It is all a question of hygiene, sanitation, and feeding. One of the most striking examples I have met with was more than twenty years ago, in an eastern district of London, where a man, employed at the great gasworks, had for years kept half a dozen hens on a small space of 6 by 3½ feet of ground, from which he obtained an average of about a thousand eggs per annum. The floor of the run was deeply embedded with sand, into which grain was dug daily to give exercise, and green food was supplied as far as available. The differences between this and the system now advocated were that a small house was used at one end, that the house was loftier than those now in use (at least 4 feet high), and that the sides of the run were wire-netted, although there was a cover over all. In the case referred to, experience had proved that when more hens were kept than the half-dozen stated the total number of eggs produced were fewer. No chickens were bred, as pullets were purchased for replacement as required.

Whatever views may be held as to the economic possibilities of intensive methods as applied to poultry husbandry—that is, in the more extreme forms—it is unquestionable that important factors not fully realized in other directions have been brought prominently forward. Such is a considerable gain. Without these it is not too much to say that the system would have failed disastrously. These factors are—(1) Scrupulous cleanliness. Neglect on that score would be fatal. (2) Using loose sand or dry earth as a floor in the houses, both for the prevention of disease from manurial action and as a means of giving exercise to the inmates, thus keeping down the tendency to internal body fat. Making the birds work for their food is ever a benefit to them, otherwise they become indolent and non-productive. (3) The keeping of dry bran in a hopper always before the birds would appear, from such experience as we possess, to be highly advantageous. The prophylactic action of bran, as distinct from its food value—which latter is probably small so long as it is in a dry state—has not been fully determined; it is a striking fact that fowls will consume considerable quantities, and we may therefore assume that instinct is a safe guide in this direction, as the palatability of the product is by no means high. (4) The use of sprouted oats, though that is not new, providing elements which are necessary to the physical health in a form which is attractive and highly appreciated. It is a moot question whether other green food would not be equally beneficial, but that, again, is a fit subject for experiment and research. One advantage is that oats can be sprouted anywhere, at any season of the year, whereas ordinary greenstuff is scarce during the winter, and many town poultry-keepers have no opportunities of growing it, whereas they can always sprout oats. Whilst no one of these factors is absolutely original, the combination is novel, and it is by way of such combinations that progress is made.

Intensive Houses.—I do not propose to devote more than a moderate amount of space to describing the houses which are

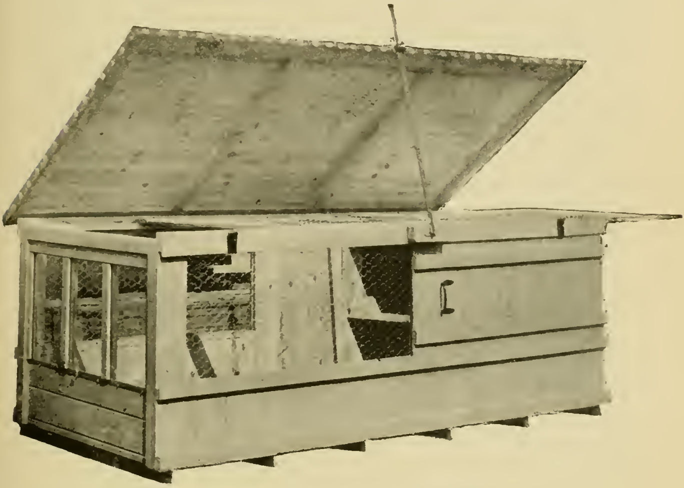


FIG. 7.—"CITY" INTENSIVE HOUSE.

being largely used under this system, if such it can be termed, for the simple reason that these have changed considerably within the last two or three years, and probably other alterations will be made in the near future. Of these are two types: First, the single house, which is usually 6 feet long by 3 feet 6 inches deep, and 3 feet to the eaves, with a flat or gabled roof, the front half of which forms a hinged cover that can be turned back to give access to the interior. The front is formed of wire netting, and may be shuttered. Inside are removable perches and egg boxes. There is no floor, and the earth below is thickly covered with sand or dry earth, in which the grain is buried, so that the inmates have to work for all they obtain. In such a coop six hens are usually kept. Second is the double-decker house, in which, by addition of an upper story, an equal number of birds are again provided for. Where that plan is adopted, the lower tier has a flat top formed by the floor of the upper compartment, on which latter sand or earth or litter gives the scratching material, in both instances kept in by strips of wood along the front. Even four-storied " poultry flats " are now in use. It will be evident, therefore, that the amount of actual floor space does not exceed 2 square feet per inmate, so that the conditions are abnormal in the extreme. Everything depends upon careful management and feeding, otherwise there would speedily result grossness of body and non-productiveness, as well as a rapid multiplication of parasitic life and loss of virility. Under the first of the above methods it is possible, where space permits, to remove the coops frequently on to fresh ground. That, however, does not afford the opportunity of exercise to the same extent as where the floor is loose and friable.

The Commercial Aspect.—Whilst it may be freely admitted that such a system as described above may be successfully applied on " city " or " backyard " lots, where labour does not count, as the operations are on a small scale, it is a totally different proposition if attempted as a commercial enterprise—that is, a mode of making a living profit. In the former we may expect a moderate addition to the food production of the country, just as it is desirable to encourage cultivation of vegetables in urban and suburban gardens. It is the endeavour to develop as business enterprises larger intensive plants which deserves and demands consideration. By use of such houses or coops it is possible to crowd more than a thousand birds in single houses, or fifteen hundred birds in double-deckers, allowing wider avenues between, on a single acre of land. That is what appeals to the many. What has to be taken into consideration is the capital expenditure and labour involved. At 5s. per bird for housing alone, which is not excessive, the single houses would cost at least £250 per acre, and the double-tiered coops £375 per acre, apart from other appliances or for the means of rearing. That, however, is the least part of it. What has to be taken into account is the labour involved. To attend to the cleaning, which must not be perfunctory, the burying of grain, and feeding, in respect of 176 houses is a task of no small magnitude. Even though, as may be admitted, the *pro rata* egg production is greater than would be the case under ordinary methods, it may be doubted whether such increase, apart from the considerations enumerated below, would compensate adequately for the greater cost involved.

Here, again, I do not attempt a full description of plants in operation, giving, however, illustrations, for the reason that the system is commercially still in the experimental stage. That there will be many "has beens," to use the expression of an American, may be anticipated. One of the latest suggestions is to house the birds in canvas-walled sheds.

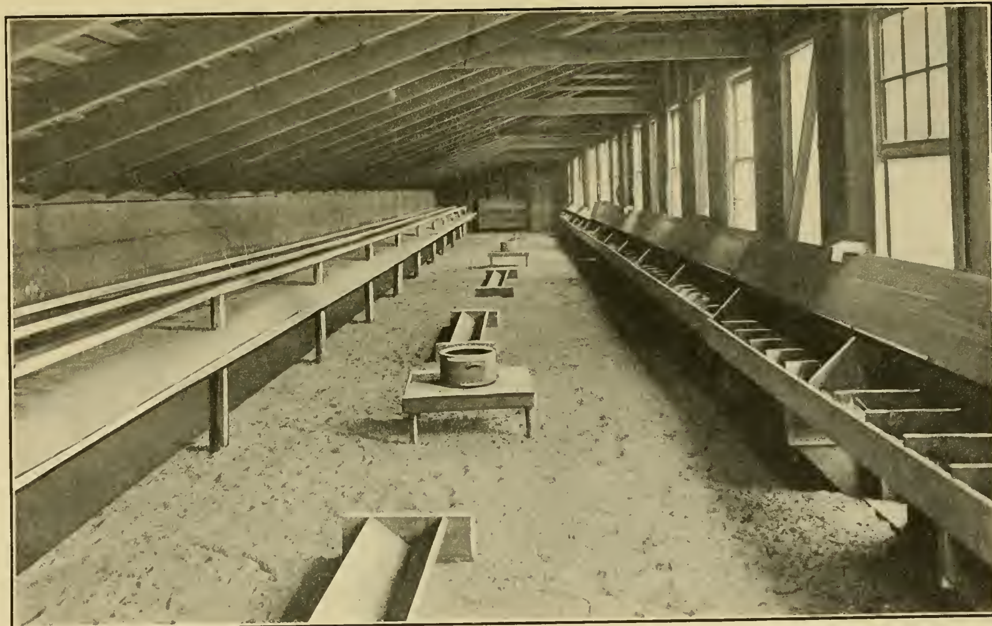
Large Intensive Houses.—For reasons which have been stated in the previous paragraphs, it is evident that the question of labour is a prime factor where operations are on a large scale. Therefore, the natural tendency has been for those who have taken up intensive poultry-keeping on industrial lines to adopt the plan of large houses and flocks rather than a multiplication of the six-unit coops already described. My opinion is that if intensive methods are to succeed, which has yet to be proved, that will not be arrived at by the "bird-cage" system, save when operated on a very small scale. These large houses have been used for many years, usually with compartments, to each of which was attached a yard or run. The later form has the run, but is not subdivided to the same extent. Apart from other considerations, the main difficulty which has hitherto been experienced is in the lack of removability of these big buildings, and the impossibility of giving that fresh ground which up to the present has been essential to permanent success. That may be accomplished by cultivation of the soil where the number of birds to the acre is comparatively small; but with a large increase *pro rata*, necessary if the system is to be profitable on industrial lines, no method with which I am acquainted is known that enables this to be accomplished. Therefore, in process of time the ground becomes "fowl sick," and can only be restored to a healthful and sanitary condition by cultivation for at least three years, during which season of rest no animal is kept thereon. That means during the period named the house would be unoccupied, which is a distinct loss of earning power. No matter what methods may be adopted, such as double yards, plus cultivation, up to the present time nothing has been discovered which will restore to the land the elements lost by overstocking, save absolute and entire removal of animals from it. Such has proved to be the case with larger stock, and the same principles apply in respect to poultry. It is upon this aspect of the problem that attention must be directed, in addition to the influence upon the birds themselves, as dealt with below.

Intensive and Semi-Intensive.—Here, again, we have two lines of operation. In the first of these the hens are kept entirely in the house provided, and are not allowed out on open ground at all. Under such conditions the area per inmate must necessarily be adequate, so as to give space for exercise, which is provided by deep litter wherein the grain is buried. An ultra-development of this system is by division of these houses so that the individual flocks are smaller, and in some instances by erecting them in two stories, which doubles the capacity. The last-named is practically the same as the double-decker small houses already referred to, but concentrated in one long-range building. In the second there is additional to the house an outside run, so that the birds can go out into the open whenever they like, although observations have shown that they spend most of the time under cover, probably from the fact that the soil is speedily exhausted of the elements which the fowls desire, and that food is supplied to them within the buildings. Addition of the run is of great value, even though it is small compared with the number of birds kept thereon. It, however, may in process of time be an ultimate causation of disease due to manurial influences.

It is evident, therefore, that the system here set forth is entirely antagonistic to the extensive method, whether applied by portable or colony houses. In these latter cultivation bulks largely, as the poultry must only be kept to the extent the land will bear in relation to its capacity for utilization of the manure produced. As a consequence, profitable cropping of the land is an integral part of the scheme of operations upon which success will largely depend, although the fowls may contribute an important part of the returns. On the other hand, intensive or semi-intensive methods depend entirely upon the poultry, as cultivation is not undertaken at all in the former, and in the latter is merely a sanitary precaution. To a considerable degree the manure is produced within the house, and can be removed, to which extent its influence is minimized. Frequently, however, that means its value is not realized. All the eggs are here in one basket. Unless the fowls can bear the entire charges for food, labour, interest on equipment, rent, etc., and leave a margin, the enterprise must fail. That is the proof of its economic value.

Unit of Flocks.—As a question of economics, mainly in the direction of houses and labour, with larger flocks the cost is relatively smaller. On the other hand, it has been frequently demonstrated that the smaller the number of birds the greater is the average egg production. That, in my judgment, explains

PLATE IV.



Interior of Rancocas Laying House.

in part the high averages obtained in laying competitions and by "backyarders," where the unit is usually four or half a dozen, which records are seldom equalled by larger flocks. Unfortunately, such a system is not economic. The expense involved for equipment and labour in, say, the six unit adopted at laying competitions is much greater than any increase of production will compensate. What we have to discover is the size of flock in which productiveness and cost will bear a due relationship, leaving a margin of recompense as profit to the owner. Generally speaking, under extensive or colony methods this is found to be, for egg production, twenty-five birds in each house, which has the added advantage that houses of the capacity named are portable to an extent that larger buildings could not be. For breeding-pens the number may be half. In such cases, however, returns are measured by the chickens obtained, and these can bear the added cost by reason of greater value.

So far as the systems under notice are concerned, there is great divergence of opinion. At one extreme is the six unit, as adopted by "bird-cage" advocates. At the other we find as many as 500 or even 1,000 hens in one flock. It is suggestive that Mr. Randolph Meech, who is the great advocate of intensification in this country, and founder of the Intensive Poultry League, states in his publication "Eggs": "I have advocated from the first that 100 should be the maximum number to be kept in one single house, and I repeat again there is not a solitary case in England where a large flock has ever been run successfully." My own view is that the main reason why smaller flocks are more productive is due to atmospheric influences—that is, when the birds are at roost. To some extent the introduction of open-fronted houses has enabled the flocks to be enlarged, but only to a limited degree. Massing of fowls means that the majority are unable to obtain oxygen in its pure state.

The Rancocas Plant.—An extreme example of what is being attempted in this direction is known by this name, situated at Brown's Mills-in-the-Pines, in the State of New Jersey, U.S.A. Here 60 acres are used for the poultry section, from which there were sold in one year 500,000 market eggs, 59,380 day-old chicks, 92,210 hatching eggs, 5,000 broilers, and a considerable number of stock birds. Seven thousand hens were kept upon the place at that time, but have since that time been increased to 20,000. Such may be termed a breeding poultry farm, as the returns from sale of hatching eggs, day-old chicks, and stock birds, were much larger than the market sales, and except for these the enterprise would have been a failure. Upon that point I need not add to what is stated in previous chapters. A number of houses have been erected for the layers, each accommodating 500 birds. These houses are 100 feet long and 14 feet wide, 9 feet 5 inches high in front and 4 feet 5 inches at the back, the roof sloping from front to back. In the front are alternately glass and muslin curtain windows, so that the house is light and fairly well ventilated. The question of open fronts is discussed in Chapter XI., to which the reader is referred. As will be seen by the illustration (p. 139), there are no divisions in the house, so that all the flock is in one compartment. Along the back is a raised platform, commonly adopted in American poultry houses, so as to give the entire floor space for scratching and to facilitate removal of manure voided at night, above which are the perches, three in number and on the same level. Under the windows at the front is a long range of nest boxes, numbering seventy-two in all, or one nest for seven hens. These have lids, which are closed down at night to prevent the hens resting on them. Down the centre of the house are food-troughs and water-tanks, the last-named on raised platforms for use in winter. It will be seen, therefore, that the actual floor space is 2·8 square feet per inmate, which is not excessive. Each house has an outside run of about 1½ acres, well shaded with trees, and fenced with 6-foot wire netting. It is in that direction where we find the weak point of this arrangement, for 500 birds on such an area must in process of time heavily impregnate it with manurial elements, in spite of whatever care is taken. Therein lie the conditions of ultimate failure. Descriptions of this plant show it to be upon a most complete "factory" scale, an indication of which is that there are nearly three miles of piping underground to supply water to the various pens. The amount of capital invested is not stated. The last and only, so far as I am aware, statement published (1910) recorded that the expenses for that year amounted to nearly £5,000, and that of the total sales 53 per cent. represented breeding stock, hatching eggs, and day-old chickens, disposed of.

A Hertfordshire Plant.—On one of the farms of Mr. T. W. Toovey, of King's Langley, Herts, the system above indicated is being tested, but with smaller flocks—namely, 150 birds in each. Near the main line of the London and North-Western Railway Company is a long, narrow field of nearly 20 acres. At one time this was occupied by small houses and pens, which have been scrapped. In place of these have been built a series of fifteen large 30 foot by 20 foot houses, to each of which is

PLATE V.

Semi-Intensive House for Layers.

Intensive Poultry House.

allocated an acre of land, divided into two parts for alternative occupation. The type of house is shown in Plate V. These houses are well built, are lofty and well ventilated. In front are large windows with netting above, which latter can be covered by sliding shutters in winter if that is thought desirable, and the solid door can be replaced in summer by one of netting. Under the fixed sloping boards is netting which is never covered. The floor is cement, covered thickly with road scrapings and chaff above to provide a scratching litter. This is spaded over frequently, and renewed about once a month. The perches are at the back, and drop-boards are not used, as Mr. Toovey does not like them. In each of these houses, as already stated, 150 birds are kept, allowing 4 square feet of floor space for each. A very suggestive and striking fact is that, although the inmates have half an acre of grass-land to run over, they hardly come out of the house. Although it was a beautiful day when my visit was paid, not a single one of the more than 2,000 hens in this field were out of the houses until they were tempted or driven out.

Intensive Plants.—The above plants may fitly be described as semi-intensive, in that there are outside runs to the houses. What now remains to be done is to deal with one farm conducted on purely intensive lines. Of such there are several now in operation, but as these have recently been founded their economic success has to be proved.

At West Norwood, which is a suburb of London, Mr. F. Palmer-Phillips hasc reated a plant on 2 acres of land, upon which 400 breeders and layers are kept, in addition to which large numbers of chickens are reared. The operations are ultra-intensive, as both old and young birds are kept entirely under cover. The houses used differ considerably, consisting of roosting compartment and covered run, the last-named open-fronted and used as a scratching shed. The latest development is that, in the newer form, the roofs are made to open, thus giving a much freer circulation of air. Experience has shown that hens kept entirely confined are healthier and more productive where the roofs open (Plate V.). Under these conditions, combined with absolute cleanliness, careful feeding and management, the laying results have proved excellent, but whether to a degree compensating for the greater cost of production I am unable to say. The chickens raised, intended as breeders and layers, and also for killing, are reared under like conditions. It is entirely a question of economics, in which respect the effect upon constitutional vigour is of supreme importance.

Effects of System.—That in many cases the productiveness of hens can be increased by adoption of intensive methods is within general experience, equally in respect to eggs and flesh. It is known that in chickens and ducklings the attainment of maturity for killing is much more rapid where a measure of what may be termed "forcing" is adopted, that the softness and quality of the flesh is considerably improved by this method, and that the profit is greater even though the cost of growing may not be reduced. The same is true in egg production, for reasons which have already been given. In the former case the birds are killed off as soon as they are ready. There are no succeeding generations to be affected. That is a prime factor making for the permanency of such a system. My opinion is that in respect to intensive egg production a similar plan must be introduced, by which is meant that breeding and laying stock must be regarded differently. In the one final reproductive values are given the first place, and in the other the number and market value of eggs accorded the front rank. Such is not necessary upon general farms, by reason of the fact that the birds are usually on range, and that there is not the same risk of degeneracy by excessive egg production, which must be taken into consideration where the methods are intensive.

From available evidence as a result of experience and observations over a long series of years—for the questions here raised are by no means new—it may be accepted that, in a great number of instances, the first effect of the systems here set forth is to increase the average fecundity, sometimes to a remarkable degree. Why that should be so cannot be stated. Probably there are several contributory causes, such as change of environment, more sheltered conditions, and better feeding, as well as the fact that those who take up this side of poultry husbandry, in many instances, usually exercise greater care in selection of their birds than do farmers, and, in the main, have a better system of housing and feeding. The point which has to be proved is whether the tendency to loss of constitutional vigour, following adoption of abnormal methods, can be prevented or minimized. If the latter alone be true, then the result is merely delayed, but is none the less certain.

Constitutional Vigour.—As distinct from the economic aspect, which must be the final test, the maintenance of constitutional vigour is of supreme importance, not alone in regard to the number of eggs produced, but to a much greater extent if the birds kept under intensive conditions are to be used as breeders. That cannot be determined by the experience of two or three years. Many of the most ardent advocates of the system are building up their thesis on the work of a couple of years or less. They have been unable to discern any deterioration in the stock, and productiveness has not apparently been affected. As I have elsewhere pointed out, it is not the modicum of lost virility in one or two years that determines the problem, but the ultimate results due to an accumulation of such influences. Too many of our ideas have been founded upon amateur or fancier experience, which has no more relationship to practical or utility poultry-keeping than has the cultivation of orchids as a hobby to potato-growing for market. If this system is to become an integral branch of the poultry industry, it will, in my judgment, have to be organized on totally different lines, and the raising of breeding stock be distinct from that of the layers, in that the former shall be kept on range. To use the words of Mr. T. W. Toovey, "I feel sure of this, that an open-air life is essential for breeders and for chickens at all seasons of the year." One further point may be here mentioned—namely, that some of those who have tried intensive methods record that losses by disease in these flocks is much greater than where extensive systems are in vogue.

Rearing of Chickens.—The basal principles of chicken-rearing are dealt with in Chapter XVI., to which the reader is referred for details of methods that have proved successful. It may be stated, however, until the fact is recognized that methods which are commendable for one purpose may be fatal in another, much loss will result. For instance, during an inquiry into the poultry epidemic which devastated Belgium in 1912 and 1913, I found upon many farms that the plan was adopted of rearing all chickens alike upon a forcing system, mainly feeding upon soft food to induce rapid growth of body and softness of bone; and when these were about twelve weeks old, selection was made from these of a number to be kept as breeders. At that age the latter are put out on the open ground, subsequently growing much more slowly than others destined to be killed. That was a desirable arrangement, so far as the latter part was concerned, but the harm already done could never be wholly recovered. Vigour of constitution does not depend upon any one factor, but many. Health and strength of the parents, environmental influences during the embryonic period, conditions and food supplied during the growing stages, all share in determining the prolificacy of pullets and the power of transmission to their progeny. Failure in any one of these directions means enfeeblement. "The strength of a chain is determined by its weakest link." When, combined with the above, there is breeding from immature stock, artificial hatching and rearing successively generation after generation, the combination of influences cannot be overcome by selection, however careful that may be. One large Belgian breeder informed me he was endeavouring to develop a race of Malines fowls that would adapt itself to breeding and rearing in confinement. That such could be accomplished may be accepted, provided the evolutionary period were long enough. In the doing so, however, the profitable qualities would assuredly be largely sacrificed, and reproductiveness be lost to a considerable extent. The adaptability of fowls, as other animals, has its limitations. Poultry husbandry as a whole must have as its foundation production for supply of human food. The great majority of those engaged in it cannot sell stock birds, etc., which is the business of a few. Methods must be adapted to the former.

The Application.—It is of supreme importance, therefore, to recognize the limitations, which are considerable. First and foremost of these is the fact that the conditions are abnormal in the extreme, and that the accumulated tendencies over a series of years will be to reduce the natural vigour of the fowls, and therefore their productiveness. It is not what is lost in one or two years, but the result if continued. Statements are being put forward to the contrary, without evidence to justify them, and they are antagonistic to all previous experience. In my judgment, therefore, hens reared and kept on "bird-cage" lines should not be used as breeding stock. What may be done is to buy sittings of eggs, or, better still, day-old chicks. Rear these and retain the pullets as layers, renewing the stock in this way every year. By this system much may be accomplished. To breed from these pullets year after year will eventuate in disaster. The buying of chicks will cost no more than would male birds; and if these are obtained from hens kept naturally, the vigour of the race will be maintained, without which all will be in vain. This question is not to be determined by the relative fertility of eggs, but by the virility of the birds. The plan here indicated will avoid all the labour and expense of hatching, whether by natural or artificial means, and to that extent reduce the cost of equipment. We may learn much from experience with other classes of stock. The town dairyman does not breed from his cows. He buys when they have calved, and sells as soon as they are going dry. Such, modified to the extent suggested above, should be applied to poultry-keeping on these intensive lines.

I may again emphasize the point that the way to permanent success is by preserving the due balance between animal and plant life, whether under extensive or intensive conditions. In this direction much may be learnt from the Chinese, who appear to understand the secret in a wonderful manner, and are thus able to maintain a very dense population; or by breeding poultry under more natural conditions, and keeping the layers intensively for the sake of their eggs. The former method has been proved to be successful. Whether the latter can be the same on a commercial scale has yet to be decided.

CHAPTER XI

PRINCIPLES AND METHODS OF HOUSING

Choice of position for the poultry must depend in large measure upon the branch of poultry husbandry undertaken, and the system which is adopted. The farmer who desires to extend and develop poultry as an integral part of his livestock must accept the conditions under which he lives, endeavouring to make the best of them in accordance with what is stated in Chapter VI. When provision has been made for hatching and rearing at or near the homestead, and the portable or colony houses to be used, he is equipped for operations on extensive lines. In that case, however, the principles laid down in this chapter as to the houses should be observed. Also it is desirable for these houses, when distributed, to be so placed that the fowls can take advantage of such shelter as is available. To a lesser degree the same is true for the small and allotment holder. Or, when one of the regular farm buildings is used as a poultry house, the conditions made should conform to these principles. Where the work, however, has to be carried out on specialist lines, as dealt with in the two previous chapters, the question of position is one which demands careful consideration. In many parts of Britain, those who intend taking up poultry husbandry on special lines have often great difficulty in finding a suitable place in a convenient position, though in this respect there has been a distinct advance within recent years, and it may be hoped that opportunities will be increased in the future. Frequently land can be obtained without a suitable house, or *vice versa*. The combination has to be sought for. Before choice is made, it is important to learn what are the conditions at every season of the year, and not to judge a place alone by its aspect in the summer time. Convenience is also a factor, though that has frequently an influence upon the rent.

Are Poultry Houses Necessary?—That under natural conditions poultry neither use nor, in fact, need enclosed buildings is certain. Accommodation of this nature is one of the results of domestication. Whilst it may be correct that housing is desirable to afford protection and shelter, more especially at night, and to minimize the influence of extremes of heat or cold, especially the last-named, with a view to greater egg production and to avoidance of loss in the elements which make for flesh development, the main reason why houses are used is that the birds may be under more complete control of the attendant, and that his labour shall be reduced as far as possible. Further, the greater the number of birds kept, the more essential is it that they shall be organized in groups, otherwise many would fall victims to their enemies. Domestication has the effect of checking the migratory instinct, by which, in accordance with the season of the year, a change of habitat takes place.

As a question of health and constitutional vigour, distinct from productiveness, houses are not desirable for poultry. Briefly stated, in those respects, the arrangement is second best. Left to themselves, they would select trees for roosting, removing from one place to another as the seasons demanded. The tendency of such system, however, would be towards reversion to the ancestral type, and to delay commencement of laying or of hatching, as well as reduction of productiveness. Cases have come under notice in which success was achieved where birds were not enclosed. Those are exceptional, and it is seldom that the conditions are favourable. At the same time such a system means limitation of opportunity, and the numbers maintained are only capable of extension in accordance with the capacity. Therefore, provision of housing accommodation is essential to development of poultry husbandry. In some districts, also, absence of trees would mean an entire want of natural shelter. What has to be sought for is form of the house in which the disadvantages can be minimized to the fullest extent, and the undoubted benefits secured. That such is possible has been abundantly proved.

Aspect and Location.—Farmers, therefore, who desire to adopt the colony method, or specialists establishing a breeding or intensive plant, require to consider what are the best conditions for such purposes. There can be no question that the southern slope of a hill is to be preferred, the reasons for which are explained by Mr. Primrose McConnell: " A hill or range of hills has always got several sides or slopes, and as the sun shines in the heavens from east round by the south to the west*—*i.e.*, when he shines

* In the Northern Hemisphere.

at all—it follows that the northern side of a hill, besides being more exposed to the cold storms which come from the north in winter, receives much less of the sunshine, when there is any in our salubrious climate. Indeed, in the winter time, when he is low in the heavens, even at midday the northern slopes may never get any direct sunshine at all. This means a very great drawback to both the plants and the animals of the farm. The pastures on the northern side of a hill are more liable to become fogged up with moss than those of the same quality of soil having a southern aspect. When the slope of the ground is at right angles to the rays of the sun—*i.e.*, about 25 to 30 degrees—it receives the maximum amount of heat, but a slope of this angle would be rather steep for comfortable farming. . . . A gentle slope facing the sun is the most suitable, while a slope away from the sun is undesirable."* For second choice we should prefer south-east or south-west. An undulating country is much better than a plain, as the latter is more exposed to prevailing winds, and seldom affords much natural shelter, whilst there is greater danger of the land being damp. Flat land should always be well drained. It is desirable to secure the advantage of such natural shelter, more especially in the shape of woods or trees, which render great service in affording protection against winds or extreme heat, both of which are equally injurious, though, of the winds, that from the east usually affects animal life most of all. Hence those whose land is exposed to the east have special need to avail themselves of such shelter as can be secured against the malign influence of the east or north-east winds, except in some sections of the country where westerly or south-westerly gales are most troublesome.

It must not be imagined that every place is equally suitable at all periods of the year. We must, as with other branches of stock, recognize that varying seasons require varied methods. Low-lying land may be excellent in summer when the season is dry, and is much better than higher, hotter soils at that period of the year. On the other hand, the higher land, if not too much exposed, would be more suitable for the fowls in winter, due to its dryer nature. Also, woodland, by reason of being cooler and affording plenty of shade, providing an abundance of insect life, cannot be excelled during the heat of summer, but would be damp, dark, and cold, for fowls in winter. Our object should be to minimize extremes, either of heat or cold. The worst of all places for poultry, either for young or adult fowls, as for other classes of stock, is the bare, treeless lands, open alike to the

* "Agricultural Geology," 1902, p. 106.

intense heat of summer and the cold blasts of winter. On larger farms the northern slopes should be used in summer, though in the United Kingdom the southern would be preferable for nine months out of the twelve.

General Principles.—Consideration is given below to questions of size and shape of poultry houses, which have their influence upon the well-being of inmates. What, however, is of greater importance is the application of hygienic conditions, so that the fowls or other poultry may have an opportunity, at least, of rewarding their owner for his enterprise. Unless that is accomplished, success cannot be expected. It is not too much to state that a vast amount of disease among domestic poultry is due to neglect of these precautions. During six months of the year fowls spend half, or more than half, the twenty-four hours on their perches in portable or colony houses, and where they are kept within enclosures probably three-fourths their time. I indicate below, therefore, principles which should be applied to all forms of poultry dwellings, whether permanent or portable, large or small. It is not so much, in my judgment, the type of house used, as whether it conforms to the requirements laid down. Fortunately, the experience of recent years has brought about changes which enable us to state clearly the conditions applicable to all such structures.

Materials.—Where poultry houses are permanent and not intended to be removed, there is no question that stone or brick houses, especially if these materals are inexpensive, are the best, although the cost is greater at first. All other houses must be of wood, which has distinct advantages. In the first place it is comparatively cheap; it can be easily handled, it may be used for a house that can be readily moved, and, what is of special importance, a house of wood built above the ground remains the tenant's property. As a consequence the great majority of poultry houses are made of wood. A large trade is done by poultry appliance manufacturers in this direction. In many cases, however, to meet a craze for cheapness, the timber employed is insubstantial or has not been properly seasoned. Green deals are cheaper than well-seasoned wood, but the result is unsatisfactory, in that during dry weather these pine and warp, leaving gaps that subject the inmates to draughts. In the case of portable huts weight has to be considered, and consequently the same thickness of boards cannot be employed as in a permanent or semi-permanent structure. Whenever possible the deals should be $\frac{7}{8}$ or 1 inch in thickness, of good quality, and be in dry condition. An excellent plan, especially in buildings which have not to be frequently removed, is to use overlapping boards laid horizontally, as these carry off water better than do deals which are tongued and grooved. In portable houses the latter are preferable, and should be vertically and tightly fixed, by which method there is less risk of water penetrating and making the interior walls damp. Whatever the form of house, it is of great importance that the framework should be strong. In the case of portable houses, whether on wheels or runners, the under-frame should be of 3-inch scantling, firmly bolted or mortised, as otherwise it would be unable to withstand the strain of removal.

One of the most important considerations in all forms of houses is to keep the interior dry. Another is to preserve the wood. To these ends the under-frames should be well tarred, and, in the case of permanent wooden erections standing upon bricks, a coating of tar should cover the top row. Tarring a house is the cheapest method. Painting looks better, though somewhat expensive to maintain. That will not be required more than once in three years, except for appearance' sake, provided good lead paint is used. Gas tar purchased in quantity can generally be obtained at about fourpence per gallon, and, if mixed with a little paraffin oil, dries quickly. Creosote is valuable in that it keeps down parasitic life. There are other preparations on the market which are very efficient for that purpose, and also act as preservatives.

Roofing.—A good roof is more than half a good house. Heat and cold are atmospheric. The roof, whatever the size and form, has much to do with the temperature of the interior. The object, therefore, should be to minimize extremes in either of the directions named. A slight covering means that in winter the house will be colder, and in summer hotter, than even the outside air, due to radiation and to the slower movement of the atmosphere. A cold wind blowing reduces the inside temperature by striking against the walls, yet not to the same extent as when the roof is inadequate. As a general rule, therefore, the last-named should be more substantial than the walls. That is secured, not by thicker timber, but by a double covering, first fixing a lining of match boarding $\frac{3}{8}$ or $\frac{1}{2}$ inch thick, above which is corrugated iron or felt, or any of the roofing materials advertised. Corrugated iron should never be employed alone, as it is a rapid conductor of heat and cold. When lined as stated above, it is excellent for carrying off the rain, and allowing air to pass along the corrugations, which acts as a cushion against heat and cold alike. When ordinary commercial roofing felt is employed, that should be fixed horizontally, with the edge of each upper strip projecting an inch above that below, and be well nailed down, for which purpose thin laths of wood are valuable. It should also be well tarred in the late summer of every year to maintain in good condition. When other patent roofing sheets are used, these should be treated as prescribed by the makers. For permanent or fixed structures, it is well worth the additional cost to use between the match boarding and corrugated iron ordinary felting, the expense of which is trivial.

Ventilation.—The late Mr. W. E. Gladstone is said to have made a statement that oxygen obtained from the atmosphere is one of if not the most important part of the food of animals. Upon this point Dr. Edward Smith, in his work on "Foods," says: "The necessity for oxygen as a food is absolute and unintermittent. . . . The body is a great oxidizing apparatus, by which it sustains its bulk, produces heat, and modifies the composition of the atmosphere, and, when it has cast off that which, having been used, is no longer useful to it, not only deteriorates the atmosphere, but renders it impure. It is not too general an expression to say that every action within the body is accompanied by the consumption of oxygen and deterioration of the surrounding air." In no direction has there been greater change of views during recent years than this. The gospel of fresh air has been, and is being, preached for human beings and all animal life. So long as men and domesticated creatures were able to spend the greater part of the day in the open, and at night find accommodation in rough structures, the question might be neglected. Concentration and increase of numbers involve considerations that would not otherwise arise. The question of abundant supply of fresh, sweet air, whilst important for all animals, is so to the greater extent with poultry, due to the fact that the body temperature is higher than that of mammals, and combustion more rapid. The temperature is maintained by combustion of the nutritive food elements combined with oxygen, exactly as a fire cannot burn unless oxygen is mixed with the carbon of coal or wood. Insufficiency of oxygen results in reduction of combustion, loss of heat, and impregnation of the blood with impurities, thus causing disease. The old notion that conservation of heat was secured by "close, cabined, and confined" dwellings, whether for humans or hens, is, I hope, gone for ever. Body temperature is maintained by consumption of various elements to an adequate extent, not by prevention of that process.

Upon this point, observations have been made at the South-Eastern Agricultural College, Wye, Kent, by Messrs. E. J. Russell, D.Sc., and K. J. J. Mackenzie, in which it was stated that (1) birds breathe about a pint of air per minute, or 1·2 cubic feet per hour; (2) with insufficient air-supply their respiration is impeded; (3) the limit of impurity should not exceed 9 volumes of carbonic acid gas per 10,000 of air; and (4) each bird requires at least 35 cubic feet of air per hour if this limit is not to be exceeded, and a freer supply was recommended. It may be mentioned that the Factory and Workshops Act for cotton operatives allows the volume under No. 3 above, but for poultry it would be desirable that the proportion of carbonic acid should be much less—nearer that of ordinary air, which averages 3 volumes per 10,000 in the country, and 4 volumes in towns. The final conclusions, arrived at, so far as smaller poultry houses are concerned, were that 10 cubic feet of air space should be allowed for each inmate.

Methods of Ventilation.—Formerly the use of small holes or louvre boards in the gables, or spaces below the eaves, or air shafts, were regarded as all-sufficient for this purpose by poultry-keepers. Such arrangements were merely playing with the question, especially where the number of inmates was large in relation to the cubic capacity of the house. In the majority of these buildings the birds underwent a slow poisoning, even where the air was pure at first, as there was not sufficient circulation to insure constant carrying off the carbonic acid gas expelled from the lungs, and replacement by an adequate volume of fresh air. All that has been changed by adoption of what is known as the open-front house, described in a later paragraph, by which the reserves of air outside can be drawn upon as required without hindrance. There is a further consideration involved—namely, that ill-ventilated houses are always damp owing to the condensation of moisture upon the interior walls, where gathers water contained in the atmosphere, the humidity of which is increased by the expelled breath of fowls. It is within the observations of everyone that in a badly-ventilated

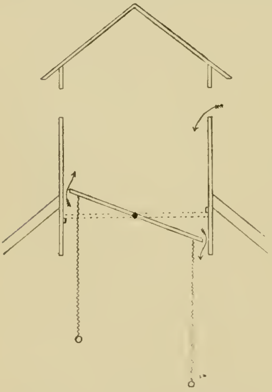


Fig. 8.—Ventilating Shaft.

room, wherein are a number of persons, moisture gathers on the walls and windows. Such is also the case in poultry houses. This moisture reduces the body temperature, and in cold weather chills the birds, causing various diseases as well as increasing the fœtid nature of the atmosphere. In large, deep houses, even where open-fronted, it is desirable also to have ventilating shafts as shown in Fig. 8.

Light.—Some years ago I was asked by the owner, who was very proud of his work, to inspect a new poultry house. Well designed and well built, according to the ideas then prevailing, save in one direction—namely, there was no provision for light, as it was a solid walled building. Until the builder realized that he had never been inside except when the door was open, and that a closed door meant absolute darkness, he could not appreciate his omission, which was very serious indeed. It is a recognized fact that sunlight is the source of heat, and also that the rays of the sun purify the atmosphere. Researches have shown that bacteria and parasites multiply much more rapidly within dwellings than in the open air, and it must be evident that, unless care is taken to prevent their increase, they become a very serious factor in antagonism to the efforts of the poultry-keeper. The effect of the sun's rays, as already indicated, is to cleanse the air, for which reason during the warmer months of the year—especially in a moist climate such as we have in this country—the parasitic increase is very much greater in dark houses than in those which are well lighted. Introduction of the open-front house, if built on hygienic principles, has effected a revolution in this direction. We have only to use our own observations in connection with human dwellings to note that, during the winter season especially, a dark room is colder than one into which the sun's rays can penetrate. In summer a poultry house, as also a room facing south, may be unduly hot, but that can be provided against in other ways. During the winter season the object of the poultry-keeper ought to be to secure the advantage of whatever sunshine there may be. If windows are used, these should be large and made to open, in addition to which there should be an unboarded space above, over which is stretched wire netting. As a rule in houses for adult poultry glass is not required.

Heating.—At one period the idea was general that, in order to obtain eggs in winter, artificial heating was desirable. The assumption was that the warmer conditions prevailing during the spring and summer months were conducive to laying, and that if these could be provided in the colder months productiveness would continue. All that has gone by the board and proved to be incorrect. I only mention the question here raised to say that artificial heat is not required, and as a question of health, which is a primary consideration, does a great amount of harm, causing debility of constitution and reduction of vitality.

Floors.—What shall be the floor within a poultry house must be determined by the class of building used, and whether it is permanent, temporary, or portable. That which might be desirable in one case would be unsuitable in another. Introduction of the scratching-shed system has worked considerable change in this direction as in others, making possible what would otherwise be undesirable. The better plan, therefore, will be to classify the houses and show the floors which are commended for each.

In large semi-intensive buildings, as these are not intended to be removed, cement is being used very largely both in this country and America. Such should be thickly covered with litter, otherwise it would be very cold and hard to the feet of the fowls. That is why it is not found desirable in ordinary houses for poultry. It has great advantages in that rats find difficulty in working their way through, and by presentation of a smooth solid surface, without interstices, there is less danger of manure finding a lodgment therein, which, unless the litter is properly treated, is the trouble with bricks, as these are very absorbent. The last-named, however, can be used where they are reasonable in price. Generally speaking, cement is the cheaper. As everything will depend upon its being well laid, the wiser plan is to employ good workmen. A few additional shillings spent in this manner will be economical, as there must be a firm bed below of stone or gravel. Unless the cement has a sure basis and is sufficiently thick, cracks will appear. Under such circumstances there should be a boundary of, say, three or four courses of brick, upon which the walls of the house will rest, and within this the bed is made with the cement laid over all. In districts where gravel is plentiful, the floor may be entirely of that material, rolling or beating down each layer as placed, using coarser at the bottom and finer on top. With the latter may be mixed a little lime or cement, and the whole rolled until it is as smooth as possible.

For smaller houses that possibly may be removed after the lapse of a few years, the same plan may be adopted as to the supporting walls, which has the effect of raising the floor above the level of the outside ground and preventing dampness. Under these circumstances gravel should be used as already commended, if that is possible. Sand is not desirable if litter is to be above, as it does not form a hard bed. Better than that is well-beaten earth. Frequently in such houses wood is the cheapest flooring —that is, where the materials referred to are scarce and dear. Whenever that is the case, the floor must be covered with litter, or sand, or dry earth, as it is absorbent, and in process of time will become charged with ammonia, though this can to some extent be prevented by tarring once a year and rigid cleanliness.

What are known as intensive houses must have wooden floors in the upper tiers. In those on the ground sand is the basis, to be dug over constantly and renewed frequently.

Portable house, whether on runners or wheels, are employed for roosting and laying only, and do not include scratching sheds. These would add considerably to the weight without any commensurate advantage, as birds on range can find abundant opportunity for scratching outside during the greater part of the year. In these the most desirable plan is to make the ground upon which the house rests its floor. In this manner the work is simplified. The manure as voided falls directly upon, and is absorbed by, the earth, so that its full value is realized. A further recommendation is that such houses are warmer in cold weather than when provided with a wooden floor, owing to loss of earth heat in the latter.

To carry out such system it is necessary that removal to another location shall be fairly frequent. We are here, however, met with a difficulty of considerable importance—namely, that, unless the walls are continued to the ground, there will be strong draughts sweeping direct to the birds, and, moreover, an easy mode of ingress is afforded to enemies. Something can be done by hinged or sliding boards, though these are seldom satisfactory or fit closely. As a consequence attempts have been made to introduce a simple but effective mechanism, by which a poultry house can be raised on to wheels for removal, and lowered when that has taken place, the walls thus resting upon the ground. Particulars of these are given later in the present chapter.

Failing such arrangement, portable houses on wheels or runners should be fitted with a substantial well-fitting wooden floor, which undoubtedly has the effect of giving rigidity to the entire structure, preventing draughts, and the entrance from below of other animals. Such flooring should be treated as already stated.

Perches.—Fowls and turkeys sleep on perches, ducks and geese do not. Therefore we have to arrange accordingly. Perches for turkeys are described in Chapter XX. My present remarks apply only to fowls, which under natural conditions roost in the trees, and generally get as high up as they possibly can. For this reason, when the birds are placed under cover, it has been thought the perches should be high. A modification has been the old ladder form of perch, one end of each supporting upright resting upon the ground, and the other against the wall. There can be no question that this form of perch enables more birds to be accommodated within the same space than if they are upon one level. It is not a form to be recommended. For various reasons all the perches should be upon the same level, and not more than 2 feet above the ground. The nearer the birds roost to the earth, the cooler in summer and the warmer in winter they will be.

So far as the perches are concerned, they may be made either of fir poles, not more than 2 inches in diameter, or of pieces of quartering, 2 inches by 1 inch, with the corners rounded off. In houses of moderate size it is better to have sockets in the walls, and drop the perches in, so that they can be easily removed; but in larger houses a frame can be built by which they are supported in the same manner. All perches should be removable to facilitate cleaning.

Many attempts have been made to improve fowl perches, but with very little success; in fact, the simpler everything is the better. Perches may be fitted to a rigid frame, hinged to the back wall, so that in the day time the whole may be raised and fixed, thus giving a greater day range of floor in a scratching shed. That is an excellent arrangement, provided the hinges are of the sliding form, so that the perch frame can be entirely removed as required for cleaning.

Nests.—Fixed nests should never be used, owing to the difficulty of keeping them clean and free from parasites, which frequently find there a harbourage. For small flocks single nest boxes without bottoms are to be commended. Where numbers are greater, allowing one box for each three hens, an excellent arrangement is to build these in one or two rows of four or more, the lower tier on a shelf raised a foot above ground, and the flat top of this tier forming the bottom of the upper. In that case the higher row should have a sharply sloping cover, to prevent birds perching on top. In this way, as each row is lifted, all the contents drop out. By limewashing the boxes regularly, and replacement of the nesting material, straw, or hay, or chaff, there should be little trouble. In larger houses an excellent plan is to have a separate laying closet or compartment, so that the hens may be undisturbed, as they prefer quietude. Where that cannot be carried out, the nests should be placed on the darker side of the house. In some portable houses a row of nests is fixed on the outside, with access for fowls from inside. The eggs are collected from the boxes by opening a covered lid. That is a satisfactory arrangement, provided the bottom board is hinged so that when unfastened cleaning is facilitated.

Trap nests are dealt with in Chapter XXI.

Draining.—Above I have dealt with the principles applicable to every form of poultry house. Before describing the different types of such houses, there is one point of considerable importance—namely, that the natural drainage should always be from, and not to, the building, in order that the floor and surrounding ground shall be dry. As a question of shelter and protection, a hollow is a desirable location; but in wet weather drainage is towards the centre of the depression, which results in sloppy soil outside, and dampness inside, the house, to the discomfort of the birds. Even where the position is a natural slope I have seen water running under or into the fowl house, whereas by a little forethought that could have been avoided. For permanent and temporary and portable poultry houses alike this is a question of importance. On level fields there is usually some choice in selection of location. The greatest danger is in low-lying valley lands, where are watercourses, as there in flood time water rises through the soil, as I have learnt by experience.

In building a large or fixed house for any purpose, it is a wise precaution to put in a series of drain-pipes leading from the building. Gutters should be fitted to the roofs, with connecting pipes well down into the earth, unless rain-water tanks are used. Small portable huts cannot be treated in the same manner. In these the roof should project sufficiently to prevent water falling on to the walls.

Original Forms of Poultry Houses.—Having stated what are the recognized principles that should be adopted to all forms of poultry houses, consideration may be given to the application of these principles. Before doing so, however, mention must be made of the older type of roosting-places for hens, still to be met with in other countries as well as our own. As a rule these occupy a section of the farm buildings. It is not too much to say that for modern purposes these are unsatisfactory in the extreme, in that they are usually small, dark, and ill-ventilated, and generally are lacking in hygienic conditions. So long as the relative number of inmates is small and the poultry are but a side-line in which the economic aspect is disregarded, not much harm is done. The danger line is passed when an attempt is made to increase the fowls beyond the capacity available for their accommodation. Better by far under these conditions, and until other arrangements are made, such as introduction of portable houses, that the birds find quarters in cart or other sheds, where at least they will have ample air space, although the system is not conducive to general cleanliness.

A very common but none the less erroneous idea has been that, to induce fecundity, warmth in dwelling-houses, cattle, and horses, is helpful. An old writer (Gervasse Markham) in 1660 suggested that the hen house should be near some kitchen, brewhouse, or kiln, which idea has permeated the minds of people ever since.

Formerly such methods were very general in the United Kingdom; and although they are still adopted to a considerable extent in the more remote areas, a great change has taken place in that respect. Upon the Continent of Europe the practice is still largely maintained, often in a very extreme form, especially where holdings are small and the cattle sheds ill-ventilated. In some cases a space is boarded off for the fowls at one end of the byre; in others the hen quarters are overhead, with a ladder entrance from the outside. Again it may be stated that when the number kept is small not much harm results; but for extended operations the system is bad in the extreme, and the sooner it is brought to an end the better.

Size of Houses.—The question of amount of space to be allocated to each fowl is better understood than was formerly the case. That has already been dealt with above under the head of Ventilation. What we have now to consider is the actual size, with which is involved the number of inmates. At the present time there is a strong tendency in the direction of large houses, accommodating from, say, a hundred to a thousand hens, for the reason that the capital expenditure per unit is less, as also is the labour involved, although compensated by reduction of the number of eggs produced. At one period these big buildings were made square, or nearly so, which meant massing the birds when at roost. The modern type is long and narrow, which is a distinct improvement for reasons stated below; in fact, were it not for the question of outside runs, not much objection could be raised to poultry houses of this class when properly built, and the perches are ranged at the back along the entire length. By that arrangement all massing is avoided, as are the risks of overcrowding.

Two important questions arise for consideration. Experience shows that there is a greater tendency to disease when birds are housed in large numbers. Should any inmate be affected in this way, it will probably spread to a much greater extent if there are, say, a couple of hundred hens in the same house, than if divided into flocks of twenty-five and scattered widely over the ground. Epidemics are seldom discerned until a considerable number of birds are affected.

The other question concerns productiveness. Observations at home and abroad have shown that the fecundity of hens when massed in large numbers is distinctly lower than when they are divided into smaller flocks. I have no doubt that this result to some extent arises from the fact that more careful selection can be made when birds are in smaller numbers, because the individuals are under closer observation. That does not, however, entirely solve the problem. Investigations have shown the importance of air, or, rather, the oxygen in the atmosphere, to every form of animal life, and that would appear to offer an explanation why birds massed in large numbers yield a smaller average of eggs than if they are divided into moderate-sized flocks. To some extent this influence is minimized in the long, narrow houses. If, however, we take a house holding 500 hens, built entirely or nearly square, it is at once evident that the great bulk of the birds when at roost cannot obtain absolutely fresh air; in fact, all those in the centre of the flock, when they are on the perches, can only obtain air that has passed over the bodies of those on the outer side, which air is to a greater or lesser extent contaminated. When birds are in small houses accommodating flocks of, say, twenty-five each, then, by a proper arrangement of the perches, nearly every bird can receive air that is uncontaminated. The birds are, during the winter season at any rate, at roost more than half of the twenty-four hours, and it is evident how important is this question. To attain the maximum of production, therefore, small flocks are preferable. It is, however, entirely a question of margin between expenditure and value of returns.

Shape of Houses.—The cubic capacity of houses in relation to the inmates has already been given. In this direction another question arises—namely, that with an increase in the number of inmates there should be an advance *pro rata* of the air space. Ten cubic feet per unit may be regarded as the minimum in small houses where no scratching shed is provided. As the size of building and number of inmates increase, so must the capacity be enlarged, both by extended floor space and elevation of the roof. So far as the latter is concerned, that is essential to effective circulation of the air. A 6-foot gable is high enough for twenty-five hens, whereas for a couple of hundred 8 or 9 feet is required. Generally speaking, additional space for scratching should, in smaller buildings, be equal to what would be provided for roosting, plus the margin beyond that actually occupied by perches. By this is meant that, if in an ordinary non-scratching house the floor space was equal to 2 square feet per inmate, of which half would be covered by the perches, then for a scratching-shed house 4 square feet of floor should be provided for each inmate. In larger scratching sheds there should be the same floor accommodation with a higher roof, and the cubic capacity may be advanced to 30 square feet per bird. Overcrowding never pays.

The shape, therefore, of the house needs consideration in view of what has been stated. As a general principle, an oblong shape as a rule is preferable to any other, the greater length forming front and back, and the shorter what may be regarded as ends. In this manner a maximum amount of light and ventilation will be secured. A square building offers no objections so long as the depth, in relation to the height of roof, at the front does not prevent full play of sunlight to the back, and also circulation of the air. One house which I have used with great success was 10 feet square (Plate VI.), and it conformed to what has been stated A deep house with a narrow front is undesirable, however well it may be designed and arranged. For the same reasons a large square house, or one deeper than it is long, should not be erected. I have seen many forms of poultry houses, in some of which great ingenuity has been expended, square, oblong, hexagonal, and octagonal, the last-named divided into compartments with corresponding runs, the prime object of which was economy of space and labour. With these half the inner compartments and outer yards could receive no direct sunlight. Even where an attempt was made to remedy this defect by roof lights and ventilators, the result was unsatisfactory, whilst the permanency of the structure generally involved ultimate trouble by tainting of the runs. Architectural fantasies in this manner are responsible for many "has beens" in poultry husbandry. Much superior in every way are the long-range poultry houses, varying in depth, according to the size, from 5 to 20 feet, as indicated below. What requires to be emphasized again is that as the depth of house from back to front is increased so must the frontal elevation. A house 10 feet deep will require a 7-foot front; one 20 feet deep should be 9 or 10 feet high in front.

For portable houses to stand in the open fields, the best type are those with gabled roofs, described later, as these are less affected by winds, and there is less danger of being blown over. In larger structures that are of a more permanent form, the sloping or shed roof is to be preferred, the front facing southwards, or as near that position as possible. Such erections, however, offer a greater surface to the wind, by which the inside temperature may be affected considerably. Therefore, in selection of position,

FIG. 9.—FARMERS' POULTRY HOUSE.

it is important to take advantage of whatever natural shelter is available. Some excellent forms of poultry houses are built with a double-pitched roof, uneven on the two sides, in which case the front slope should be the shorter, and not carried down to the same degree as at the back. Experience has shown that the low-front roofed building is not so satisfactory as when the highest slope is frontal.

Portable Poultry Houses.—Regarding equipment of farms in the first place, there can be no question that the form most suited to these conditions is that which can be moved about from place to place as occasion requires, and made to fit in with the rotation of crops. Such houses can be placed out on grass or arable land, according to the season of the year, with great advantage to the farmer, as the fowls clean the land and enrich it by their manure. It has been found that by the adoption of the plan here advocated the cash gain is very considerable. Food which otherwise would be wasted is obtained by the fowls, and they can thus be fed much more cheaply than if kept on one place or in confinement, whilst the advantage in giving them fresh ground is very manifest. Upon fields which are down for hay it is not necessary to remove the poultry until about ten

Fig. 10.—Portable Poultry House with Outside Nests.

weeks prior to cutting, which avoids all danger of the grass becoming trodden, and the crop comes strong and in good condition. On arable farms they can be placed out before the plant appears, when it is well up, and after harvest. On dairy farms it is found that fowls do not interfere with the cattle, or the cattle with the fowls, and the maintenance of several hundred head of poultry need not necessitate the reduction in number of the cows on a large dairy farm. On a farm largely devoted to grain and roots, the houses can be placed in corners of the fields where grain or roots are growing; and though for a yard or two around the ground is bared, that is all the damage which results. The birds wander in and out among the grain stalks and growing roots without injuring them, and render service in other ways. It is commonly thought that fowls injure growing crops, but experience has proved that, after the plants are 6 inches above ground, there is no risk whatever in so doing, and great good results from the adoption of this plan. On fruit grounds and in hop gardens the benefit is even more apparent.

Where the house is not required to be moved more than once or twice in the year, the form shown in Plate VI. can be adopted, as the labour of taking the erection down and re-erecting is

FIG. 11.—IDEAL POULTRY HOUSE : FRONT VIEW, LOWERED.

small. For this purpose it is built in sections and bolted together. Under these conditions wheels are not required, and it is used without a floor. Upon grass-land, the plant in and immediately contiguous to the house would be injured, if not killed, and consequently this house is preferred on arable farms. On grass-land the work of removal is greatly facilitated if wheels are fitted, so that labour is minimized. In that case the additional cost is speedily saved. Fig. 9 represents the ordinary form of poultry house upon wheels, fitted with a wooden floor. For reasons which have been fully explained, it is much better that the ground should be the floor. If removal takes place once or twice a week, no injury to the grass results, and the manure is well distributed.

With a view to avoid the use of wooden floors and to retain the mobility of poultry houses, methods have been introduced of raising them upon their wheels for removal, and of lowering again when in position. Various attempts have been made in this direction to introduce such a mechanism, but the result has not been wholly satisfactory, due to the increased strain upon the house and the labour of removal. As a consequence, up to the present the ordinary type upon four wheels and with a wooden floor is preferred. Figs. 11 and 12 show a house upon three wheels, which by a powerful lever arm, shown at the side of raised house, it is lifted up and fixed. The reverse action restores it to the ordinary position, when the wheels can easily

Fig. 12.—Ideal Poultry House: Back View, raised.

be taken off by removal of the pins, and thus one set of wheels be used for several houses. In experience, however, I have found that, unless the wheels are large, these houses do not travel well on rough ground, which is a question of considerable importance. There is abundant scope for inventiveness in this direction.

Many of the ordinary portable houses are insufficiently ventilated. The upper half of one side should be wire-netted. In Fig. 13 it will be seen that a shutter is provided, which is made to slide up and down. Whilst occasionally in wet weather that may be useful, the less it is utilized the better.

Colony Houses.—Where this system of poultry husbandry is adopted, removal of the house is not requisite more than once

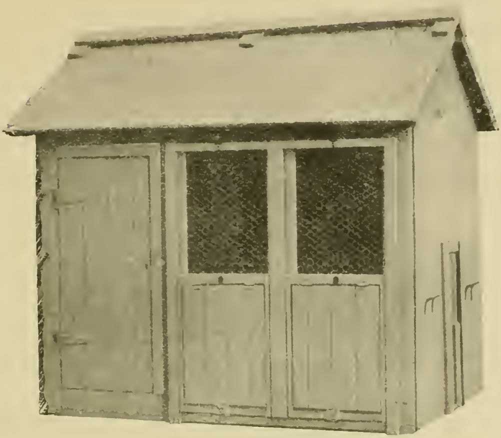


Fig. 13.—Tenant Farmer's House with Shutters.

Fig. 14.—Canadian Apex Colony Houses.

a year. As a consequence wheels need not be employed. Under such conditions a larger building on the scratching-shed principle is to be commended. It should be built in sections and bolted together, by which means removal is facilitated, and does not involve a great amount of labour. Houses to be used in this manner should be of medium size, holding, say, twenty-five birds, and in all cases be open-fronted. One of the best forms is that shown in Plate VI. Various other types are illustrated, from which selection can be made. Reference may also be made to the description given in Chapter VIII. of the colony method adopted at King's Langley, where groups of small houses or coops are used, one advantage of which is that these can be removed easily.

Scratching-Shed Houses.—Nearly all modern houses of a larger size for fowls, with which I am acquainted, save such as

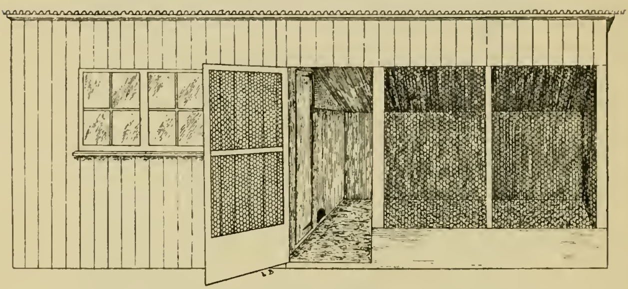


Fig. 15.—Large Scratching-Shed House: Front Elevation.

are intended to be frequently moved, are being built on what is known as the scratching-shed principle, which is capable of great extension. The objects in view are twofold: First, that the birds may have shelter in unfavourable weather, and, if necessary, be kept entirely under cover; and, second, that they may be induced to take abundant exercise, as food is supplied in litter and has to be worked for by scratching. The latter of these is the more important. Fowls on range—that is, at liberty—do not require any such provision so far as exercise is concerned, for, if not overfed, they will be busily engaged all the day long seeking for food, and thus keep their organs in activity. A larger house, in the absence of natural shelter, is useful on that account. When kept under restricted conditions, the tendency is towards a lethargic habit of body, as a consequence of which,

PLATE VI.

Range of Single Scratching Sheds.

especially when feeding is abundant, fatty deposits accumulate on the muscles and organs, which tend to reduction of productiveness, and often lead to liver and other digestive troubles. Introduction of this system has undoubtedly made possible a great increase of poultry-keeping on what are moderately intensive lines. Briefly stated, intensification in any form would be practically impossible except for this method.

Scratching sheds are of many forms, but agree in essential details. One of the earlier types is that shown in Fig. 15. This consisted of a building of which the illustration represents half, each section being 18 feet long by 10 feet deep, the front 7 feet 6 inches high, sloping to 5 feet at the back, thus obtaining all the sunshine possible. It included a roosting and laying compartment 8 feet by 10 feet, and the scratching shed 10 feet square, the partition and door solid, except the upper part of the former, which was netted. The front of the roosting compartment was solid except for the window, which was made to open, and that of the scratching-shed section wire-netted. If now building such a house, I should make all the front netted and entirely dispense with the partition. Experience has shown that in the United Kingdom, for the number of inmates, twenty-five, the size was greater than was necessary. It was, however, built on American lines. In that country, where the winters are much more severe than with us, frequently it is necessary to keep the fowls entirely under cover for several weeks together, in which case a greater amount of shelter is warranted. Therefore, as a protection against snowdrifts, the plan in many instances is adopted of having a frame upon which is stretched fine glazed muslin to fit behind the netting. When not in use, it is hung up against the roof so as to be out of the way. In this country such an arrangement is needless. I came across several plants in America where the birds were kept in houses of this class during the greater part of the year, and there is a tendency to that form of intensification in our own country at the time of writing. That was not, however, carried out with the houses named. Outside was, first, an enclosed gravel run to each section, 20 feet long by 18 feet wide, in which the birds spent most of their time, and, second, a single grass run for the two lots, 100 feet long, by 36 feet wide—that is, the width of the two sections, the inmates of each using it alternately. The great advantage of the gravel run was that, as the bulk of the manure fell there or inside the house, it could be removed in the former by daily sweeping, the labour of which was more than compensated by the manure thus gathered. As a portion was carried by rain into the gravel, it was found necessary to remove and replace the latter from time to time. The material could, however, be used again when exposed for a time to the weather, and thus washed clean. In spite of all that was done by cropping and planting fruit-trees, the grass in the outer run became very rank, and the conclusion was reached that such a method could alone be successful if applied on arable or dug land, for which purpose at least double runs, one back and the other front, would be necessary to provide an alternation.

Another form which was found superior is shown in Plate VI. This was a single house, 10 feet square, of the same elevation as the other, placed in a run of a quarter of an acre, with gravel around, but no enclosed yard. Inside at the back was a laying compartment for trap-nesting, and the perches. The front was netted. The cost of single houses is a little more, but the advantages of mobility fully compensate. Such was one of the best forms I have used.

The Litter.—An essential factor in these houses is that a considerable portion of the floor space, all except that under the perches, is thickly littered with straw cut into short lengths, or chaff, or peat moss, or any other friable material which will not bind or bed hard. The deeper this is, the better. What it shall consist of is largely a question of cost. In the corn States of America I have seen great stacks of straw burning because it was of no local value, and not worth the cost of transportation over long distances. With us it is too expensive as a general rule. Thus chaff or peat moss are usually employed. On this the grain fed is thrown. As the birds commence to scratch, it is buried or can be raked in. Every time they use their claws to uncover one grain, they cover up the rest, and in this manner are exercising themselves all the time. That is, in brief, the virtue of the system—namely, working for their food and keeping their muscles and organs in good order. In districts where sand is plentiful that material may be used, in which case the grain should be buried more deeply. As a rule a thick bed of litter lasts several months, if dug over regularly, and then forms a valuable manure.

Open-Front Houses.—Reference has previously been made to the important part which oxygen plays in connection with the animal frame. A sufficient supply of that element is essential to productiveness. Warmth may be a stimulus to activity of the egg organs, but tends to increase the fatty deposits on the body, and its effect is transient. Even in America, where the climate is more extreme than with us, it has been found that winter egg production depends more upon oxygen, plus vigour of constitution, than anything else. Lack of oxygen and of exercise means lessened digestive power, and therefore waste of food.

For these reasons what are known as open-fronted houses are becoming more general. Several types are shown in the illustrations. These vary considerably in size and design, but the same principles should be applied in all cases. The front is made entirely of wire netting for preference, save that it is boarded immediately above the ground, and is never closed in any way winter or summer, the perches being placed at the back. When this system is adopted, the back, ends, and roof, must be substantial and air-tight. As a result there is a free circulation of air without draught. When a gale is blowing if we enter a shallow doorway the air rushes past, and does not disturb the atmosphere in which we are standing, so that a pipe can be lit without difficulty. Under the conditions named, therefore, the fowls are quite comfortable—in fact, more so than when in close buildings. It is found that on the coldest night frost does not reach them, and there is no condensation of vapour on the walls. The body feathers afford all protection required. It is damp which causes trouble, and, when combined with low temperature, frosted combs, chills, etc., are caused, which are practically unknown in open-fronted houses. Sometimes shutters are used for very cold weather, due to the fearfulness of the owners rather than the needs of the birds. Save as a protection against rain, these are a useless expense. In this type of building windows are not required.

When the open-front houses were introduced in America, dread as to the effect of low temperature led to the use of curtain screens, either behind the wire netting at the front, as described above, or around the perches. Professor W. R. Graham, of the Ontario Agricultural College, Guelph, states that, after careful tests made with warmed buildings, with double-walled houses having curtains before the perches, and also 6 feet away next to the wire netting, he had found that the one-ply board houses with netted fronts had given the best results as to the number of eggs produced in winter, of fertility, and vigour of germs. Whatever may be the case across the Atlantic, curtain fronts are useless on this side. One exception may be made—namely, that in a very hot summer to hang green holland behind the wire netting will be well worth the cost, keeping the interior cool at a time when the heat is very trying.

Range Houses.—Ever since I have taken any interest in poultry husbandry there has been periodic, if not constant, striving for the successful adoption of long-range houses, of which there are many forms. Some of these are duplications of compartments for a lesser or greater number of fowls, with corresponding runs outside, varying from a hundred to the thousand unit flocks in one great but long mass. Where the weakness lies is not in the house itself, but by the accumulation of manurial elements on the surrounding land, and the fact that change of environment is practically impossible. Personally I should never build again a range house.

One of the best forms I have seen was that designed and constructed by Mr. W. Reynolds, of Leigh Nook, Street, Somerset, upon the scratching-shed principle, and with double runs. These have been designed to accommodate a flock of 200 pullets, with the double purpose of obtaining winter eggs and selecting by recording nests the best layers for the following breeding season. The idea was to lessen as much as possible the labour involved in attending to such a large number. The range (Fig. 16) consists of eight sheds, each 14 feet 6 inches by 12 feet 6 inches (including the passage, the space underneath which is used by the fowls), with a food store, etc., at one end. A raised passage, 18 inches above-ground, runs the entire length, with doors on one side leading to each of the front runs, and on the other to the sheds. Once in the passage, which has a door at either end, the soft food can be placed in the feeding-troughs, the water vessels cleaned and refilled, the recording nests examined, and the trap to either front or back runs opened or closed by cords, without being hindered by a single door. In the house shown are nine trap nests, but in four out of the eight houses there are only eight nests, a broody-coop taking the place of the missing one. The floor of the sheds is raised with road earth 3 inches above the surrounding ground-level, and during the whole winter is kept liberally supplied with litter—*i.e.*, waste and broken straw, chaff, etc., from threshing machines. In very cold or wet weather the pullets are entirely confined to their houses, and two half-feeds of grain are fed amongst the litter. The night perch is at the back, with a dropping-board beneath.

The passage is divided from each shed, and from the front runs, by wire netting. In very bad driving wet or cold weather, wind shutters, formed of canvas or battens, are filled in each panel of the front against the wire netting. Part of the front slope of roof has glazed lights fitted, which can be opened or altogether taken away. The houses benefit thus in winter from the sun, and in very hot weather there is ample ventilation.

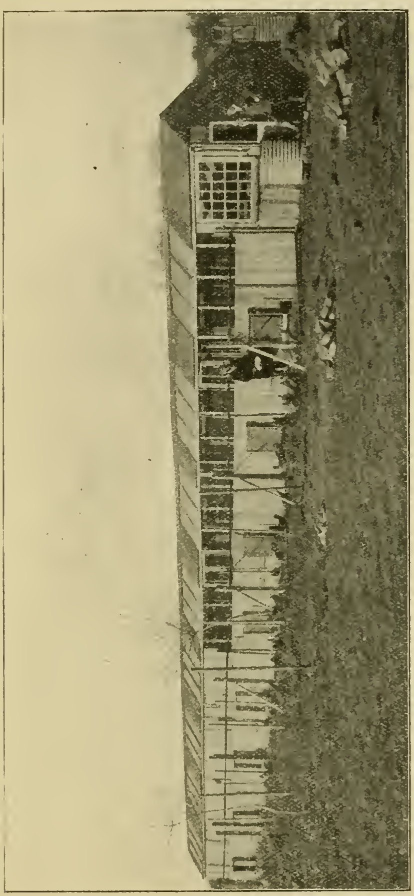


FIG. 16.—LEIGH NOOK SCRATCHING SHEDS: GENERAL VIEW.

The rest of the roof, together with the back and two ends, are formed of tongued boarding covered with good roofing felt, thus making the houses draught-proof. It will be seen that each house has two runs, the front ones having two orchard trees in each, and at the back, where the houses afford some shade, there is only one.

The first length (12 feet 6 inches) of fence in front is formed into a gate, and by opening all of these back on to the runs, even if in use, and closing the traps, all the birds are secure, and a cart or waggon can pass along the front to deliver road earth or litter, and to collect manure or tainted earth.

Small Poultry House.—In these days houses of a fairly suitable class for poultry can be purchased at very low prices, due to the numbers that are manufactured to one pattern. So long as these, or in fact any, conform to the principles already laid down, they can be commended. The same is true of such as are built at home. Cheapness may be dearly purchased, however, if the material or construction be deficient or unsuitable, or if the conditions are unfavourable for the inmates. As a rule fowls and, it may be added, other classes of poultry should not be kept in gardens or upon very small spaces; there should be a reasonable amount of cover in order to afford protection during unfavourable weather. A very excellent arrangement is, in the case of a house of the usual pattern—say, 5 feet square, or 6 feet by 5 feet—to make an extension of the roof covering the run for 8 or 10 feet beyond the house. Such a construction is not only useful in giving shelter, but also, when in a garden, if netted round, during periods of the year when the birds cannot be given any liberty they may be kept there all the time. Under such conditions the run should be laid down in gravel, which can be swept regularly so as to remove a large part of the manure; or in sand, to be dug over occasionally; or in fine ashes. The last named, however, will require to be renewed once every three or four months. Sometimes very elaborate and ornate poultry-houses are provided in this way, by reason of the fact that the owners wish for a place in keeping with the surroundings. To that there can be no objection, so long as the essential principles laid down are observed. To sacrifice the health and comfort of the inmates for appearance' sake is undesirable, and also unnecessary. On the other hand, to please the eye is generally worth the doing. It is not the palatial or rough structure which determines the comfort and health of the inmates, but whether it insures the protection desired, combined with hygienic conditions. Such dwellings may be made very inexpensively. Sugar casks, piano cases, and large boxes, can be turned into useful poultry huts by the expenditure of a little time and ingenuity. Even if new or other timber has to be purchased for the purpose, the cost is comparatively small, and there is a considerable amount of pleasure obtainable in the execution of the work. Where the amount of ground space is very restricted, a plan often adopted is to raise the floor of the house so as to provide shelter below, and to increase the size of run. This arrangement undoubtedly has the effect of making the inside colder in winter. That, however, may be minimized by keeping the boards covered with peat moss or other litter. If such a plan is adopted the floor should be 27 inches above the ground, and the earth under the floor and in the run should be raised higher than the level outside to insure dryness. This may be turned into a scratching shed; in fact, wherever fowls are kept under strictly confined conditions the scratching shed is indispensable to a full measure of success.

Shelter Sheds.—Poultry on range do not require any special provision in the shape of shelter. They are enabled to find that for themselves, unless the place is bare and exposed. As a rule such birds are better able to bear exposure, in that they have been inured to it by their conditions, and are compelled by exercise to find that warmth which arises from a more rapid circulation of the blood. It is where they are compulsorily under restricted conditions that they feel the effects of exposure. Where scratching sheds are used nothing more is needed. These give protection equally against wind and rain. One of the best arrangements I know is on the breeding establishment of Mr. Simon Hunter, at Northallerton, where small spinneys have been included in the large runs used for breeding pens, in which the birds find shelter from excess of sunshine, rain, or wind. For obvious reasons that arrangement is not always possible. If the fences are boarded up a couple of feet, this acts as a wind-break, but is not otherwise of much service. Shelters can be improvised by hurdles interlaced with furze or branches of trees. These may be made by lacing a couple together, or building square, in which case four will be required—that is, three sides and one on top. Another good form is of wood with four solid partitions set transversely, the fronts open so that the birds can go into whatever side they desire. If built 3 feet high and 6 feet square, each section will give a ground space of 9 square feet. It is, however, entirely a question of cost.

Fences and Yards.—Wire netting has been described as a necessary nuisance. The less used the better. Where permanent houses of any form are employed, it is essential to separate the runs, in order to keep the birds to their own location. For this purpose the cheapest and best material is wire netting, a good quality of which will last for years. It is made in rolls of 50 yards, and can be bought through the ordinary channels of trade at reasonable prices. Where chickens are likely to be kept in these runs, the mesh should not be larger than 1 inch; but for adult fowls an ordinary 2-inch mesh is to be preferred, and offers the maximum of strength with the minimum of expense, as the smaller the mesh the greater the amount of wire employed and the cost of making. The height of fencing must be determined by the class of poultry to be enclosed. Heavy birds can be restrained by a 3 or 4 foot fence, whereas light, active breeds can, if they wish, surmount 8 feet fencing without difficulty. My experience has been that, provided that there is a good grass run and the birds are well employed, a fence 6 feet high is ample for practical purposes even with the light-bodied breeds; if netting is used to that extent, and the supporting posts carried 1 foot higher, with a single strand of wire stretched all around the runs on tops of the posts, this will prevent their flying over. A 6-foot fence is generally suitable to the houses, and looks better than one either higher or lower.

For fixed runs the plan is to drive posts or fir poles, 3 by 2 inches in diameter, into the ground, and upon these fix the netting. For a 6-foot fence the posts should be 8 feet long and pointed. They will last much longer if well tarred or creosoted before they are driven home. Before this is done, gates should be fixed so as to facilitate work in management of the poultry. An extra gate or two leading from one run into another, and to the outside fields, will often save a great amount of time. Hence it is desirable to think the question well out in advance. Where runs are arranged side by side, unless they are divided by solid partitions, the male birds will quarrel and often injure each other, as well as worry themselves by the sight of their rivals. For this reason the bottom 2 feet of the fence should be closely boarded, or sheets of corrugated iron used to that depth. Not only is this useful for prevention of fighting, but it also affords a degree of shelter against wind, and adds to the comfort of the inmates, at the same time greatly strengthening the fence Where the plan recommended is adopted, the netting need not be continued to the ground, but merely to the top of the boarding or corrugated iron, overlapping a little to prevent gaps through which the birds might pass.

The appearance of wire netting is greatly improved when it is stretched tightly. That is the difficult part of the work of erection. An excellent plan is to run a strand of wire along the tops and bottoms of the posts, so that not only is the netting fixed by staples to the posts, but also fastened by tying wire to the strand. If the netting is drawn downwards by the side wire and fixed to the boards or corrugated iron, it will have the taut appearance desired. Where this plan is adopted, the posts may be 10 or 12 feet apart, or in accordance with the length of the sheets of corrugated iron; but if entirely netted they would need to be not more than 6 or 8 feet from each other. It is desirable that gates should be hung well, and be wide enough to permit a cart to pass through.

Most important are the fasteners to the gates, for neglect on this score may mean heavy loss by mixing the breeding pens, and by the cock birds fighting. I have known as much injury done in this way by a bad catch, or leaving a gate unfastened,

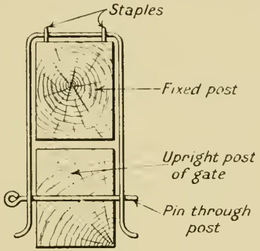


FIG. 17.—BENT IRON-WIRE FASTENER FOR GATE.

as would have paid the cost of good fasteners for the entire plant. For the same reason a gate should consist of a stout wooden frame, the bottom of which is solid, and the upper part formed of wooden laths 2 inches apart, as they have to withstand strong winds. The upright posts should be firm, and if a cross-piece is fixed across the top that keeps them in position. Should the gate be double, then a bottom cross-piece may be fixed also, so that bolts can be used on one half above and below. That is not required for single gates. For fasteners many forms are available. Only those, however, should be selected which can be worked from either side. One of the simplest I have known is made of stout bent wire, and can be prepared by any blacksmith. It is shown in Fig. 17. A pin of the same wire in the fixed post prevents it falling below the horizontal, and if made just a shade larger than the post it is firm, and can be operated either within or without.

Hygienic Conditions.—So far as the houses are concerned, the importance of cleanliness cannot be too strongly emphasized. Dirt is said to be matter in the wrong place, and dirty conditions mean discomfort, and often disease. Where birds are on range, the only point needing consideration is that the house shall receive attention in this direction, though not nearly to the extent essential in fixed dwellings. In the last-named, however, the chief danger lies in the outside runs, as the risk of tainted soil from manurial contamination is ever present.

It has been shown that a well-fed domestic fowl will produce nearly 100 pounds of moist manure per annum, varying considerably in accordance with the feeding. Upon that question more is said later. This manure is of considerable value in connection with the cultivation of the land, but that is not the point we have to consider at the present time.

Where fowls are kept in confinement, it is frequently the case in poultry-yards that every blade of grass is absolutely killed, and the top crust of the soil becomes little better than a manure-heap. Under these conditions we can easily understand how disease is certain to result and great loss ensue. In connection with agriculture, however, there is no excuse for that state of things. The demand upon all cultivated land is more and more for manure, in order that it may become of greater fertility. Consequently, if the birds are scattered about and not concentrated upon one place, so that their manure is widely distributed in accordance with the needs of the soil, then the benefit must be considerable; but if the same fields are used year after year, or the birds are simply kept about the farmyard, then in process of time the ground becomes tainted and disease is bound to result.

CHAPTER XII

GENERAL MANAGEMENT OF THE BREEDING STOCK

Capacity to produce is generally, if not always, present to a much greater extent than the actual results would indicate. How far this capacity can be realized is as yet an unsolved problem. The factors which are at work for development of the inherent reserves are unknown save to a very limited degree. Upon this point Professor Eugene Davenport says:* "For present purposes the animal body may be regarded as a colony of organs, each endowed with its own peculiar function, the life of the whole and of every member being dependent upon the degree of success with which each portion does its work. The whole is, therefore, as strong as its weakest member, and when the whole is put to work in service for man, that service will not only depend upon the functional activity of the special organ involved . . . but also upon the successful discharge of all vital functions when subjected to the unnatural strain involved in working under pressure. The point at which the machine will break down or fail to do successful work is, therefore, a matter of relative strength of parts." The practical application of what is here stated is that, additional to suitable houses and environment, management in other directions must be satisfactory in every way, otherwise the results desired will not be achieved. It has been said that the environment is permissive rather than assertive. What we have to do is to clear out of the way hindrances to development and production. We are very slowly and somewhat painfully learning what these hindrances are. Too often are they created.

Where Management tells.—One of the most successful poultrymen I have known explained as his secret that he left the birds alone. A great truth is here involved. He did not mean that they were neglected. Everything in reason was provided for

* "Principles of Breeding," p. 87.

them, but he depended upon their instinct rather than his own. He helped as far as was in his power, but never fussed. When things did not turn out quite as was expected, the cause was sought for, and, if possible, remedied. Forcing was not resorted to. Selection, however, was made in accordance with adaptability to the immediate conditions, and in this way the productiveness was advanced. It is frequently found that the differences in results obtained by two people living under practically identical conditions vary to a remarkable degree. There must be capacity in the owner as well as in the hens. He requires to know what to do and when to do it, also when not to be passive, and to utilize his knowledge. The fowls, however, must be responsive to his treatment.

The better bred the poultry and the larger the operations, the more important is this question. When the stock are of a rougher type, and are maintained under more natural conditions, they are able to bear a harder environment. In that case the exercise of their capacity is restricted, and they are usually less productive than if more carefully bred and fed. The cost, however, of maintenance is much less, so that the margin of profit may be actually greater. We have, however, to remember that, unless poultry husbandry can be developed among those who must make profit by enhanced production, even though the cost of doing so is increased, the volume of supplies will be sensibly decreased. As previously shown, the number of poultry kept in this and other countries is in inverse ratio to the size of the holding.

Causes of Infertility.—This subject is of special importance in the case of breeding stock, the number of eggs from which is not the supreme object, but that the eggs shall possess a capacity for producing strong, healthy, virile young birds, whatever the species may be. It is undoubtedly true that many eggs laid have not this capacity, in that they are not fertilized by the male element. An infertile egg is a *rara avis* in a wild bird's nest. Domestication has resulted in a largely increased number of eggs produced by the individual hen, which may mean that the development of the ovaries is greater than the glandular activity can meet, so that the ovule entering the oviduct is not fertilized. A further cause is probably due to a greater strain upon the male, especially where he is used for a prolonged period, than he is able to meet. In this respect, also, seasonal influences may operate in a way unknown to us. Fertility is seldom as high in the autumn and winter as during the normal breeding season—that is, the spring. That may be climatic, or, as has been suggested, due to the reduced supply of green food and parasitic life. And, further, the reproductive functions may be retarded if the body is not in a condition to permit the organs to operate freely, as, for instance, when the tissues and organs are covered with fatty deposits. Normally birds are hard and lean in condition when the season for breeding arrives. What we should seek to do is to bring them into the same state of body at other periods if fertile eggs are desired. That can be accomplished by reducing the supply of food and making them work for all they obtain. There can be no question that fresh air, to supply an abundance of oxygen to the body, does much to prevent infertility in eggs. Therefore, as a question of exercise, the recommendation has been several times made that breeding stock should be on range, and be kept in open-front houses. Also that they should not be yearlings, but fully matured in both sexes.

Weak Germs.—What is commonly called "dead in shell" is the *bête noire* of the poultry-breeder. In these eggs the germ has been vitalized, but has not sufficient vigour to attain embryonic maturity. My own belief is that this arises, in the majority of cases, from debilitated constitutions in the parents, as it is found to be greater where the stock are weakened from any cause. Sometimes death takes place after hatching has been completed—that is, during the early stages of chickenhood. As contributory causes may be named—improper conditions for hatching, want or excess of moisture, lack of attention on the part of the hen, or irregular working of the incubator. And, further, a hen in the natural state selects her own nest, and does not commence to lay until the right season has arrived. I feel confident, however, that the chief cause of infertility and death in shell is owing to lack of reproductive vitality in the parents. Unless that is present, the germ and embryo cannot have a fair opportunity for development. These are the conclusions and observations at home and abroad. In addition must be regarded the fact that a hen may transmit disease germs to her progeny through the egg. Observations made in connection with the epidemic which devastated the poultry of Belgium in 1912 and 1913 showed that the microbe causing the disease in chickens had been traced in the parent hens and the eggs laid by them. And in the same way the male may infect eggs by the oviduct.

Number of Hens to Male.—Some of the more vigorous males will serve from ten to twenty hens, according to the season of the year, and less would be hurtful to the hens; whilst there are others, less vigorous, for whom ten hens would at any time be too many, and in the colder season half a dozen are sufficient.

There is, of course, also a difference in individual hens of the same breed, and no certain rule can be given that will apply to every case. For utility poultry, as a rule, eight in the heavier breeds, and twelve in the more active, are safe numbers. If the hens seem to be distressed, and show this by the loss of feathers on their backs, then more hens should be given at once. If the number of hens be small, and it can be accomplished, the male need not be with them all the time. There is also another cause of infertile eggs when birds are in confinement, and one which is often unsuspected—viz., that the cock bird does not get sufficient food. His gallantry to the ladies of his harem leads him to see that they are all fed before he partakes of any food, and if there is only a limited supply, or they are fed by an attendant who only throws down as much as the birds appear to eat greedily, then the probabilities are that he will not get a sufficient supply. When the male is found to be losing flesh rapidly, he should be carefully observed. The scratching-shed system obviates this difficulty.

Nests.—Although it is not easy to give an absolute reason for doing so, I have always felt it desirable that breeding hens should be provided with a somewhat larger proportion of nests, than where they are merely kept as egg producers, and that it is profitable to pay special attention to cleanliness in and position of the nest boxes, as in the houses also. Whatever conduces to the comfort of the birds at this time, within reason, is desirable, though that does not mean they should be pampered or so fed as to become gross in body. In fact, as stated in the next chapter, the evidences are that, whilst soft food may be useful to promote laying, better and stronger eggs are obtained where corn is the main supplied food, and exercise fostered by scratching. A further point is that the nests should be in a quiet place, so that the birds may be undisturbed. How many malformed shells are due to the hens being affrighted or interfered with is not known. Probably more than has commonly been suspected.

Sex Influences.—From the earliest period study of and speculations upon the determination of sex have been general, even as far back as the time of Aristotle. That there must be some ininfluence by which whether the egg shall produce a male or a female is decided is evident. It is, however, one of the many secrets which Nature reserves to herself. Hundreds of theories have been promulgated—some with more and others with less probability. In a few cases we have apparently had nearly sufficient data to arrive at a workable plan of operations. Then, again, the elusiveness of this problem has revealed itself. In practice these all break down. One of the latest suggestions, and with some elements of probability, is that the food reserves—that is, the body condition of the mother—is the determining factor in mammals, which would mean that the richness of the yolk in birds, as a result of better feeding, is what decides the sex—namely, that high condition tends to a greater number of females. Here, again, however, tests have not confirmed the theory, and the breeder has to accept the fact that he is unable to control the sex. It would certainly be a great gain were this within his power, for to the majority of poultry-keepers pullets are the more desired. The world was interested some years ago by introduction of an instrument, the inventor of which claimed that it would tell the sex of even an egg. A few successful guesses resulted from tests made, but in practice it hopelessly broke down, and therefore I need not refer to it further.

Mental Impressions.—A very common idea has been that mothers during the time of pregnancy are susceptible through the sight to influences which may affect the progeny. Scientific observations have failed to reveal actual cases more than could be explained by ordinary variations. In the case of poultry, as the embryonic period is after the egg has been laid, the influence, if such existed, would be before the ovule left the ovary. The breeder of these species, therefore, may ignore such theories, as also what is known as telegony—that is, the influence of the first male upon future progeny than his own.

Duration of Male Influence.—Many observations have been made to learn the duration of influence of a male bird in respect to the fertility of eggs. The latest of which I am aware are those made by Professor J. L. Frateur, of Louvain University, Belgium. The first test was to discern how long the influence remained after removal of the cock. Three lots of hens were tested. Whilst there were considerable variations—namely, that in one lot three eggs laid on the eleventh day were all fertile, and in another, out of three laid on the thirteenth day, two were fertile—of two lots none were fertile after the fourteenth day, and in the other after the thirteenth day, although the experiment was continued for four weeks. The second test was in the reverse way. Five lots of hens were mated, with which had been no male for forty days. The results show that no egg on the first day was vitalized; on the second day seventeen eggs were laid, of which eight were fertile; after the second day the majority of eggs were fertile. It may be assumed, therefore, that two clear days should be allowed after mating takes place before the eggs are used for hatching.

CHAPTER XIII

THE FEEDING OF POULTRY

It is impossible to over-estimate the importance of the question of feeding. Hence the relative value of different feeding-stuffs, and their effect upon the birds, require full consideration. There are two reasons for emphasizing the importance of this subject. In the first place, it deals with the process of preparing food for human consumption; that is a matter of national concern. Dependent upon it to a certain extent is the public health. In the second place, the ultimate position of poultry husbandry is determined by the possibility of feeding successfully at a cost that will allow the realization of a substantial profit. Unless this latter is attainable, all endeavours to establish and carry on a profitable industry are futile.

Natural Food.—The wild progenitors of present-day races of domestic poultry subsisted entirely upon the materials which they were able to obtain for themselves. That, therefore, should be the basis of all feeding, though, seeing that greater results are expected from domesticated poultry than from birds in their wild state, the natural food must in every case be supplemented by other feeding-stuffs. It is necessary in this connection to consider what may be obtained naturally. There is not sufficient evidence to enable a definite statement to be made, describing all the various substances that birds gather from the earth. Information on this point is inadequate. It is possible, however, to mention some of the forms of food that are thus obtained. These comprise worms, slugs, insect life, seeds, lime, various salts, and small, sharp stones. Two facts may be definitely stated—namely, that natural food is superior to any artificial or fed food, and that it varies in nature according to the season of the year, and in accordance with the special requirements of the body at these seasons.

It will suffice for our purpose if we deal with the question generally, and not in detail. In the wine-producing districts of France, large flocks of poultry are allowed to wander for the greater part of the year over the vineyards. It is found that by this practice they not only obtain a large supply of highly nutritious food, but at the same time they clear the growing vines of injurious forms of insect life. In view of the above it may be stated that, though contrary, perhaps, to general opinion, gravel or sandy soil are not the best for poultry, but that loam with a gravel subsoil and a substratum of clay is superior. Further, a heavy clay, for birds that are given their liberty, is better than pure sand.

Liberty the Ideal.—The ideal method of poultry-keeping—from the point of view of successful and economical feeding—is that which allows birds their liberty. Under such conditions they are afforded an opportunity of obtaining a supply of natural food. There are various systems of poultry-keeping, and the amount of natural food that birds will gather depends entirely upon which system is adopted. These methods have been referred to elsewhere, but it is necessary to re-enumerate. Although there may be graduations between the different systems, it can be generally accepted that three methods are in common use. These are the extensive, the semi-intensive, and the intensive systems. The amount of natural food that will be obtained by the birds under these methods may be described respectively as considerable, slight, and nil.

Artificial Foods.—To insure success in poultry-keeping, natural food must be supplemented by artificial—that is, supplied feeding-stuffs. From what has been stated above, it will be realized that the quantity of artificial, or fed, foods must depend upon which system is adopted. In the case of the intensive method, given that other results are equal, it can only be considered successful when increased production is sufficient to repay the added cost of feeding. This is a point that must always be considered. As evidence may be submitted the following: Under farm poultry-keeping conditions there are many who are able to feed their fowls for a sum not exceeding 2s. 6d. to 3s. per bird per annum; whereas it is found under the intensive system that the food consumed may have a value of 7s. a year and upwards. If the increased production under the latter conditions is sufficient to make good this difference, then it is possible to say that both systems are equally successful.

Food Constituents.—All foods, whether natural or artificial, are composed of various constituents or groups of compounds.

Considered from a chemical standpoint, these are as follows: (1) Water; (2) nitrogenous substances; (3) fats; (4) carbo-hydrates or starchy material; (5) fibre; and (6) ash.

1. *Water:* Is present in greatly varying quantities. For instance, in young clover there is about 92 per cent.; in certain other foods as little as 8 per cent. Water has no feeding value, but is a necessary constituent.

2. *Nitrogenous Matter:* Forms feathers, skin, blood, muscle, and the greater portion of the egg.

3. *Fats:* Provide the necessary oily secretions at the joints and under the skin, and assist in maintaining the body temperature. In the case of birds for eating, fats soften the flesh, in that they replace the water which is present under normal conditions in the body.

4. *Carbo-hydrates:* These supply the necessary heat and energy to the frame, muscles, and organs.

5. *Fibre:* Consists of the cell walls of the plant, and is of little use to poultry. Although it is built up of the same elements, and in the same proportion, as the last-mentioned group of compounds, it possesses different characteristics. Food passes so rapidly through the digestive system of the bird that fibre is hardly acted upon at all by the various digestive juices, or the bacteria or organisms in the intestines. The bird body differs in this respect from that of an animal.

6. *Ash:* Composed of salts, and is of considerable importance to the system. As yet the exact value of this constituent is not known. Sodium salts are a valuable addition to the food of animals. Little information, however, has been collected with reference to the action of salts in the case of poultry.

Available Artificial Foods.—No definite conclusion can be arrived at with regard to foods and their value, until we understand the exact proportion in which the above-mentioned group of compounds are present. Every vegetable substance contains the whole six. Animal substances contain all but the fourth (carbo-hydrates). There are no carbo-hydrates or starch in the animal body.

Although we have classed the various constituents into six groups, it must not be understood that all substances in the same group are equally valuable as food. That is not the case. A proportion of the nitrogenous material, the fats, and the carbo-hydrates, are indigestible—*i.e.*, they are not acted upon by the digestive juices, and are therefore of no value as food to the body. The monetary value of a food is determined by the percentage of the digestible organic matter that it contains, whereas the feeding value is governed by the proportion, or the ratio, between the nitrogenous substances on the one hand, and the heat-producing or non-nitrogenous constituents—that is, fats and carbo-hydrates—on the other. This is termed the nutrient or albuminoid ratio. The formula by which this ratio is determined will be explained later. In the table on p. 192 is given a list of the principal feeding-stuffs, together with their analysis, including total digestible organic matter and the nutritive ratio. Wherever possible the percentage of digestible constituents is given, but in some instances that is not possible..

It has been considered better to give fully these particulars for a large number of foods, although the majority are not in ordinary use. These are all, however, eminently suitable for poultry-feeding, and the only determining factor is their market value. If two feeding-stuffs of a similar nature can be purchased at the same figure, the one containing the larger proportion of digestible organic matter is the cheaper. Realization of this fact enables the poultry-keeper to save considerably on his food bill.

Influence of Cooking.—One of the effects of cooking is in certain instances to decrease the percentage of digestible nitrogenous matter, but only a small proportion is affected in that direction. Cooking with the majority of foods is beneficial; especially is this the case with feeding-stuffs that contain a large proportion of fibre. If such foods are cooked before they are fed, the small loss in the percentage of digestible albuminoids is more than compensated by the greater ease with which the other constituents are acted upon by the digestive juices. In any case, whether cooked or uncooked, wet mashes should always be fed warm, and not cold. That is most of all important in cold weather. With a cold wet mash a certain amount of body-heat is utilized for raising the contents of the digestive tract to the same temperature as the body itself. This body-heat is supplied by the food, and therefore, when a cold wet mash is fed, a certain proportion of the food is wasted.

Requirements of the Bird Body.—To enable the body, together with the various organs and muscles of which it is comprised, to fulfil its proper functions, there are certain requirements that must be satisfied. In the case of a chicken the material must be supplied from which the increase in size can be derived. Adult birds require a similar material for upkeep of the body, or, in other words, to repair the waste of tissue that is constantly taking place. The nitrogenous matter supplies this need.

Foods.	Water.	Albuminoids or Nitrogenous Matter.	Fats.	Carbo-hydrates.	Fibre.	Ash.	Organic Matter (without Fibre).	Albuminoid or Nutrient Ratio.
Artichokes (Jerusalem)	80·0	2·0	0·2	15·5	1·3	1·0	17·7	1 : 8·0
Barley	14·0	7·7	2·3	56·1	4·9	2·7	66·1	1 : 8·0
Beans	14·0	24·0	1·5	48·0	2·5	10·0	73·5	1 : 2·1
Beans (Soya) ..	10·80	34·0	16·9	28·8	4·7	4·8	79·7	1 : 2·0
Beanmeal ..	14·5	23·0	1·4	43·6	9·4	3·1	68·0	1 : 2·0
Brewers' grains ..	76·6	3·9	0·4	9·5	6·2	1·2	13·8	1 : 2·7
Brewers' grains (desiccated) ..	12·0	18·7	8·1	49·0	7·9	4·3	75·8	1 : 3·3
Buckwheat ..	14·0	6·8	1·2	44·0	15·0	1·8	52·0	1 : 6·9
Buttermilk ..	90·1	3·0	1·0	5·4	—	0·5	9·4	1 : 2·5
Cabbage	89·0	1·1	0·2	6·0	2·0	1·2	7·3	1 : 5·9
Clover hay ..	16·0	4·5	2·2	34·6	26·5	6·2	51·3	1 : 2·7
Cow's milk (separated)	90·5	3·9	0·4	4·5	—	0·7	8·8	1 : 1·4
Cow's milk (skimmed) ..	90·0	3·0	0·6	5·6	—	0·8	9·2	1 : 2·3
Dari	8·9	13·1	4·6	67·1	1·9	4·4	85·8	1 : 5·9
Hempseed ..	12·2	12·2	30·2	15·0	12·1	4·5	57·4	1 : 6·9
Lettuce	93·0	0·7	—	4·7	0·6	1·0	5·4	1 : 7·0
Linseed	12·3	17·2	35·2	15·3	7·2	3·4	67·7	1 : 5·5
Linseed-meal (extracted)	9·7	28·7	4·0	29·4	6·7	7·3	62·1	1 : 1·3
Lucerne (green) ..	74·0	3·2	0·3	9·1	9·5	2·0	12·6	1 : 3·1
Lucerne hay ..	16·5	12·3	0·9	31·4	26·6	6·8	44·6	1 : 2·7
Maize	14·4	8·4	4·8	57·8	5·5	1·5	71·0	1 : 8·2
Mangold-wurzel ..	88·0	1·1	0·1	9·1	0·9	0·8	10·3	1 : 8·5
Meal (granulated)	—	63·24	13·32	—	—	—	—	—
Millet	14·0	9·5	2·6	43·1	9·5	3·0	55·2	1 : 5·2
Oats	14·3	9·0	4·7	41·8	9·3	2·7	55·5	1 : 5·8
Oatmeal	10·5	8·5	3·6	48·2	14·5	6·8	60·3	1 : 6·6
Peas	14·3	20·2	1·7	49·9	6·4	2·4	71·8	1 : 2·7
Peameal ..	11·4	20·9	2·8	55·4	4·5	3·5	79·1	1 : 3·0
Potatoes	75·0	2·1	0·3	20·6	1·1	0·9	23·0	1 : 10·1
Rape forage ..	87·0	2·0	0·4	4·8	4·2	1·6	7·2	1 : 2·85
Rice	14·0	6·9	0·3	72·7	2·2	0·5	79·9	1 : 10·6
Sunflower-seed ..	8·0	11·1	21·2	28·1	28·5	3·0	60·4	1 : 6·9
Turnips and swedes	89·4	1·3	0·1	6·3	1·3	0·6	7·7	1 : 5·0
Wheat	14·4	11·7	1·2	64·3	3·0	1·7	77·2	1 : 5·7
Wheat bran ..	13·6	10·6	2·4	44·4	8·9	5·6	57·4	1 : 4·7
Wheat middlings ..	12·5	14·6	3·4	61·6	4·7	2·9	79·6	1 : 4·75
Whey	93·2	0·8	0·3	5·0	—	0·6	6·1	1 : 7·1

(For the above I am indebted to Mr. Primrose McConnell's "Agricultural Note-Book," and other sources.

Again, oily secretions are essential to the well-being of the bird. These can only be obtained from the fats contained in food. The body also requires heat and energy, which are found in the carbo-hydrates and the fats. A portion of the latent energy is transformed into mechanical power, whilst the residue is changed into heat. Lastly, in the case of feeding for egg production, the body requires material from which the eggs can be formed—namely, albuminoids for the most part. Where fattening is the object in view, a special form of flesh is wanted, and the substances for its construction must be provided by the food.

Food Digestion and Assimilation.—It has already been shown that all foods, with the exception of animal substances, contain each of the necessary constituents in varying proportions for the upkeep of the bird body. How these various constituents are rendered available is now to be described. It must be stated at this juncture, however, that all food is considered to be outside the body until it has been assimilated—*i.e.*, absorbed into the blood. It is only the products of digestion which can be made useful in this manner.

To state the matter simply, it may be said that the whole object of digestion is to render soluble the insoluble digestible constituents in food. Whether whole grain, meal, green food, milk refuse, or animal food, is considered, we find the whole is in an insoluble state. The various juices secreted by the organs of the alimentary canal act upon these constituents, thus rendering them soluble. Soluble materials are termed the products of digestion. The actions that take place in the digestive tract are as follows: The food is taken through the mouth, and passed by means of the œsophagus into the crop; here it is mixed with a secretion similar in many respects to the saliva of mammals, which acts upon the carbo-hydrates or starch, and converts this group of compounds into sugar. The food continues its way until it reaches the stomach; here another juice—the gastric—is poured in, which converts the insoluble albuminoids into soluble peptones. The saliva and the gastric juice continue to act during the passage of the bolus of food through the remainder of the alimentary canal. Their action is not confined to the space of time during which the food remains in the crop and the stomach. Passing still farther, after being ground in the gizzard, the food reaches the small intestine, where by means of two more secretions—the bile and pancreatic juice—part of the fat is converted into soap, that helping to emulsify the remainder. In addition, these juices have the power of acting upon any starchy or albuminoid material that has hitherto been left untouched. What little fibre or cellulose is affected is broken down by means of organisms in the intestines. At this stage all the products of digestion are soluble, ready to be received into the blood. This is brought about in two ways: part is absorbed directly through the many small veins that intersect the walls of the intestine, the remainder being absorbed by means of villi, or organs in the wall of the intestine connected with the lymphatic system. After traversing that system, the soluble constituents are poured into the blood in the jugular vein. When once in the blood, the products of digestion are carried throughout the bird, to be used for all the requirements of the body.

It has already been pointed out that the fats and the carbo-hydrates are both utilized for the production of heat force. It is necessary, however, to refer at this stage to the difference in value between these two groups of compounds as regards the function which they both perform. One pound of fat will generate as much heat as 2·29 pounds of carbo-hydrates. Therefore, in calculating the nutrient ratio of any food, this fact must be taken into consideration. To obtain a ratio the nitrogenous compounds are compared with the fats and the carbo-hydrates, or, in other words, with the non-nitrogenous substances. To determine the ratio the percentage of fat must be multiplied by 2·29, in order to bring it to the equivalent of starch, added to the carbo-hydrates, and divided by the albuminoids. For example, the analysis of Jerusalem artichokes—the first food mentioned in the list of feeding-stuffs—is 2·0 per cent. albuminoids, 0·2 per cent. fats, and 15.5 per cent. carbo-hydrates. To calculate the nutrient ratio the following formula is used:

$$\begin{array}{c}\text{Albuminoids} : \text{Fats} \times 2{\cdot}29 + \text{Carbo-hydrates} \\ \text{or } 2{\cdot}0 : 0{\cdot}2 \times 2{\cdot}29 + 15{\cdot}5 \\ \text{or } 2{\cdot}0 : 15{\cdot}958 \\ 1 : 7{\cdot}979 \\ \text{or practically } 1{\cdot}8\end{array}$$

This means that for every part of digestible nitrogenous or flesh-forming material there are eight parts of heat-producing constituents in the food. To determine the albuminoid ratio of a mixture, the percentage of each constituent in each individual food used should be added together, and afterwards work out the result by the formula as given above. In other words, the total fats are multiplied by 2·29, added to the total carbo-hydrates, and this result divided by the total albuminoids.

The demand of the bird's body varies according to the conditions under which it is kept; therefore at this point it can only be stated that the body requires an albuminoid or nutrient ratio of from 1 : 4 to 1 : 7. Under the heading of Food Tables this requirement is treated more fully.

Hard Food and Wet and Dry Soft Mashes.—Apart from the question of green food and milk products, foods can be divided into grains and meals. There are two or three ways in which these substances can be fed. As a general rule—the only exception being in the case of water-fowl—the grains are fed in a dry state, either given whole or milled. Meals can, however, be fed either in the form of a crumbly, moist mixture—a wet mash or soft food—or in their original condition, forming a dry mash. The former of these is the one generally used in this country. Feeding a dry mash—in self-feeding hoppers—is practised to a considerable extent in America and Canada, and, so far as experience has gone, with excellent results. The introduction of the dry mash system of feeding is to be advocated under certain conditions among British poultry-keepers. There does not appear to be any difference whatsoever in the digestibility of the meals, with the exception of the point to which reference is made above, when fed wet or dry. Moreover, hopper feeding undoubtedly saves a considerable amount of labour, both in the preparation of the mash and in the feeding itself, although it may be more costly. The practice as followed in the States is to use hoppers with a capacity sufficient for a week's supply, the daily operations being confined to giving one feed of corn in litter and replenishing the water-troughs. The fowls do not appear very keen on the dry mash, hence its use tends to make them take exercise in scratching for the corn.

Whenever possible, hard grain should always be scattered in litter covering the scratching-shed floor, given that the litter is of such a nature as to render this practicable. In the case of birds that have their liberty, roosting in portable houses, if the weather is dry, this form of food can be thrown on the ground, but care must be taken that too great a quantity is not so fed. In wet weather it should be placed in a trough under cover. Soft mashes should always be trough-fed, otherwise they are likely to become contaminated by the birds' feet and the excreta on the ground. A dry mash, as has already been stated, is fed in a self-working hopper.

Whether the wet or the dry mash method is employed, supplemented by the use of grain, and whether, in the case of the former, the wet mash is fed as the first or the last meal of the day, must necessarily depend on the system of poultry-keeping that is adopted.

Methods of Feeding.—As already pointed out, there are three systems of poultry-keeping—namely, (1) the extensive, or range; (2) the semi-intensive; and (3) the intensive. A different method of feeding is desirable under each set of conditions.

The principal secret of successful feeding, judged both from the economical and the production standpoints, is to keep the birds actively hungry during the day, giving them as much food as they will consume about an hour before they go to roost. The term "actively hungry" is intended to denote that degree of appetite which is sufficient to encourage the birds to look for more food themselves. The gathering of food, whether it be of a natural kind, as when birds are given their liberty, or artificial, as when buried in the litter of a scratching shed, conduces to health, in that the fowls must take exercise in securing what they require. The importance of this fact cannot be overestimated. A bird that is lazy can never be profitable as a layer, hence the advantage of adopting a system that will hinder the fowls from exhibiting this characteristic.

If fowls are given a free range, there will be a large source of food-supply at their command, which acts as an incentive to wander over the land in search of the special forms of natural food they desire. Under these conditions the first feed in the day should consist of a wet mash, given as early as possible. Only sufficient of this mash should be fed, however, to take the keen edge off the appetite, thus encouraging the birds to search for a further food-supply. When the ground is hard, and consequently the supply of available natural food is limited or entirely absent, rather more wet mash should be given. In open weather, and in districts where the soil is rich in natural food, the first feed should suffice until the evening. Under other conditions a small feed of grain, together with green food, may be given at midday. The last feed should consist of dry grains, and the birds be allowed to eat as much as they will. The wet mash mixture should have approximately an albuminoid ratio of 1 : 5 in winter and 1 : 4·5 in summer, and the corn 1 : 7 and 1 : 6 respectively.

When birds are accommodated in runs, whether these be small, for a limited number of occupants, or large, as on the American colony system, they are said to be kept semi-intensively. Under such conditions the area over which they can wander in search of food is considerably curtailed, hence they are deprived to a great extent of the natural food they would otherwise obtain, as that is rapidly exhausted. Under this system the tendency is for the fowls to become overfat and sluggish in their habits. A method of feeding must be adopted to circumvent that result. As this system of poultry-keeping is midway between the extensive and the intensive methods, practically any order of feeding may be followed. (*a*) A very small feed of wet mash may be given in the morning, followed almost directly with a scattering of corn in the litter, supplemented by a meal of green food at midday, and completed with a full feed or corn at night. (*b*) The dry mash hopper system may be adopted. A self-feeding hopper is kept constantly before the birds, and grain is also scattered in the litter. Green food is given in addition. (*c*) Lastly, the grain can be buried in the litter, overnight if thought desirable, a feed of green food be given at midday, and a full feed of wet mash at night. If suitable foods are employed in each case, there is no difference in results. Approximately, the albuminoid ratio of the mash is 1 : 4·75 in winter and 1 : 4·35 in summer; of the corn, 1 : 6·6 and 1 : 5·8 respectively.

The intensive system, as mentioned in a previous chapter, is comparatively new, although, in a different form, it has been followed for many years by backyard poultry-keepers. Every precaution must be taken under intensive conditions to keep birds in store condition. Exercise is essential to their well-being. Methods (*b*) and (*c*) as described for feeding under semi-intensive conditions are both suitable for birds that are kept in absolute confinement. Method (*b*) is better when large flocks are housed together, and Method (*c*) when the pen consists of only some six to a dozen fowls. It is possible, however, to feed coarser foods, or those containing a greater percentage of fibre, but having the same nutrient ratio as above, under intensive conditions.

Animal food is necessary in one form or another with growing stock and laying hens. It will be noticed that this is included in all of the specimen food tables which follow. An excellent form of animal food is buttermilk, and where practicable that should always be employed in preference to other kinds.

Food Tables.—It is obviously impossible to give a large number of mixtures for feeding under the conditions enumerated above. Appended are specimen diets, all of which have proved of value. Others can be determined upon by the poultry-keeper with aid of the table of analysis and a knowledge of the local market value of the various ingredients.

FOR BIRDS AT LIBERTY.

WINTER.

Soft Food.

Maizemeal	3 parts.
Peameal	1 part.
Barley-meal	1 ,,
Bran (wheat)	1 ,,
Potatoes (cooked)	3 parts.
Meat (granulated or meal)	½ part.

Hard Food.

Wheat or Dari	1 part.
Barley	1 ,,
Maize	½ ,,

SUMMER.

Soft Food.

Barley-meal	2 parts.
Middlings	1 part.
Bran	1 ,,
Clover hay chaff (steamed)	1 ,,

Hard Food.

Wheat or Dari	2 parts.
Oats	2 ,,
Dari	1 part.

FOR SEMI-CONFINEMENT.

WINTER.

Soft Food.

Maizemeal	2 parts.
Beanmeal	1 part.
Barley-meal	2 parts.
Bran (wheat)	1 part.
Potatoes (cooked)	2 parts.
Meat (granulated or meal)	⅜ part.

Dry Mash.

Maizemeal	3 parts.
Beanmeal	1 part.
Barley-meal	3 parts.
Bran (wheat)	2 ,,
Clover-meal	1 part.
Meat (granulated or meal)	⅜ ,,

The meat (granulated) may be fed in a separate hopper.

Hard Food.

Wheat or Dari	1 part.
Barley	1 ,,

SUMMER.

Soft Food.

Barley-meal	1 part.
Middlings	2 parts.
Bran (wheat)	1 part.
Meat (granulated or meal)	¼ ,,

Dry Mash.

Same as above, less 1 part of maizemeal.

Hard Food.

Wheat or Dari	1 part.
Oats	1 ,,

Under the intensive system, as already stated, coarser foods may be employed, such as a larger proportion of bran and hay chaff; but these substances must only be increased when other feeding-stuffs are decreased to such an extent that the final albuminoid ratio of the mixture remains approximately the same.

Adjuncts to Feeding.—There are certain substances that are beneficial, even if not essential, to the well-being of all birds, and I propose to treat them apart from the ordinary foods. These consist of green food, green bone, grit, charcoal, and water.

Green food for poultry is essential. Under conditions that have already been described, the fowls will be able—during the greater part of the year—to gather sufficient for themselves. Those that are kept in semi-confinement, or are entirely without the advantage of a grass run, must be provided with this form of food. The nature of green food must necessarily vary according to the season of the year. At all times, however, it forms an indispensable item in the diet. It may consist of lucerne (exceptionally valuable), lettuces, cabbage leaves, turnip tops, swedes, turnips, mangold-wurzels, or Jerusalem artichokes. In fact, any form of succulent vegetable material may be used. All of the above-mentioned green foods should be fed in a raw state, and not cooked. The only food of a like nature which should be cooked before feeding is potatoes, which should not otherwise be fed. Mention is made of artichokes, since these not only form a good green food—available during the greater part of the year—but the shade they provide when growing is acceptable in unprotected or exposed positions.

Reference has been made in a preceding paragraph to the value of animal food. Green bone is an animal product which should have a definite place in the list of feeding-stuffs. Its value has been considerably overrated as regards laying stock. It, however, contains a large quantity of phosphatic material, which is very beneficial to all growing birds. The fresh bones are cut into very small pieces, and fed either separately or mixed with the wet mash.

To enable the birds to digest their food, they must be supplied with grit. This consists of sharp pieces of flint or stone, which collect in the gizzard, and are there used for grinding the food. If this is not obtained naturally by the birds themselves, it must be provided. A small box of grit—flint for preference—should have a place in every yard.

Without going into detail, we may state that vegetable charcoal, and willow charcoal if possible, is a very valuable addition to the ordinary feeding. Very few poultry-keepers in this country realize its value, but I strongly recommend its use. As a preventive against disease it is unequalled, and as an agent for aiding digestion its value is considerable. The most satisfactory way to feed charcoal is to break it into very small pieces and feed in a self-acting hopper.

The last adjunct to feeding is water. That is an essential item, and must on no account be overlooked. Dirty or stale water is readily contaminated by disease germs, and thus transmitted to the birds; hence it must be given in suitable fountains or dishes, and always be renewed at least once every day.

Use of Condiments.—The use of condiments is to be recom mended only in such cases as require a tonic to tune up the various organs of the body. Condiments are all stimulating in effect, hence they require careful usage. If this fact is borne in mind, poultry-keepers cannot go far wrong. The continued use of large quantities of any tonic is bound to result eventually in the organs becoming pathologically affected. During a spell of severe or inclement weather, a little mustard, or other condiment, may be given with good effect, but on no account should these stimulating substances be fed after the necessity has passed. A number of the proprietary compounds on the market are very good, but the cheapest tonic is mustard.

Purchase of Foods.—When purchasing foods, it is generally a wise policy to take only the best quality, since the percentage of digestible organic matter is proportionately higher. The one exception is in the case of wheat. The first-grade seed is more floury than the second quality—and, moreover, proportionately dearer—therefore the latter should be selected. If the table of analysis is studied carefully, it will prove of great assistance to the poultry-keeper, helping him to determine which is the most economical food to buy. For instance, it is sometimes possible to purchase Manchurian millet or Kaffir corn at a cheap rate. These are similiar in analysis to dari, and can be used with equal success. One word of warning must be given in this connection—namely, that it is unwise to purchase mixed corns or mixed meals. It is impossible to say exactly the nature and quality of the various ingredients, and, as they are generally sold at a low figure, it is obvious that something must be lacking.

Chicken Feeding.—The feeding of chickens is all-important. Upon the nature and the quality of the food depends the future economic worth of the bird. Injudicious feeding may cause premature death, or stunt the growth to such an extent that the bird will be of little value when it reaches maturity.

The subject of chicken-feeding is fully discussed in Chapter XVI., and we refer the reader thereto. The particulars that have been given with reference to the feeding of adult fowls apply also to young birds, and therefore the present chapter should be read in conjunction with that to which reference has been made.

CHAPTER XIV

FORMATION OF THE EGG AND CHICKEN

An egg has been well described as " a mass which forms in the ovaries and oviducts of a large number of animals, and which in a common envelope encloses the germ of the future animal, with the liquids destined to nourish it during a certain lapse of time, when the vital impulse has been communicated to it by fecundation and incubation." This is true so far as fertile eggs are concerned; but though the object of the egg is undoubtedly to envelop the germ, yet impregnation of an egg by this germ has no influence upon the actual laying thereof, and a hen will lay at the proper season independently altogether of her being mated with a male bird. Millions of eggs are laid every year which would never hatch, simply because they contain no germ, not having been fecundated. It is a very common idea, but an erroneous one, that in order to keep hens laying they must have a cock bird running with them. That such is altogether wrong is easily proved in practice, as there are many who keep fowls without a male bird, and yet have an abundant supply of eggs.

How an Egg is formed.—The form of an egg is well known (Fig. 18), with its two diameters, one of its length and one of its breadth, a small end and a large one. Eggs vary in weight according to the breed and age of the hens, but eight to the pound, or 2 ounces each, is regarded as a fair size. The outer envelope or shell is white or coloured according to the species, and is composed of carbonate of lime, phosphate of lime, and animal gluten. Salts of lime give the shell its hardness, and cause the particles to adhere. Soft eggs are those that have no shell, or which have too thin a shell, and are deficient in salts of lime. Hence the necessity for introducing lime into the food of the fowls. It is surprising where a hen finds all the carbonate of lime necessary, for if she lays 100 ordinary-sized eggs in the year, she will have produced about 22 ounces of pure carbonate of lime. Thus, as Mr. P. L. Simmonds, F.L.S., observes, if a farmer has a flock of 100 hens, they produce in eggshells about 137 pounds of chalk annually; and yet not a pound of the substance, or perhaps not even an ounce, may be found on the farm. The materials for the manufacture are found in the food consumed, and in sand, pebbles, brick-dust, pieces of bone, etc., which hens and other birds are continually picking from the earth. Their instinct is keen for these apparently innutritious and refractory substances, and they are devoured with as eager a relish as the cereal grains or insects. If hens are confined to barns or out-buildings, it is obvious that the egg-producing machinery cannot be kept long in action, unless materials for the shell are supplied in ample abundance. If fowls are confined in a room, and fed with any of the cereal grains, excluding all sand, dust, or earthy matter, they will go on for a time and lay eggs, each one having a perfect shell, made up of the same calcareous elements. Vauquelin, the distinguished chemist, confined a hen for ten days, and fed her exclusively upon oats, of which she consumed 7,474 grains in weight. During this time four eggs were laid, the shells of which weighed nearly 409 grains. Of this amount, 276 grains were carbonate of lime, 17½ phosphate of lime, and 10 gluten. Of course, it is more than likely that there was some amount of reserve stock of shell-forming substances in the body ere the hen was shut up, and that if the experiment had been continued longer shell-less eggs would have been laid. Still, it is a fact that there is only a little carbonate of lime in oats.

The shell is porous, or permeable by the air, without which the chick could not live during the process of incubation. The white, fragile, outer envelope is composed of mineral matter, but is not the light, compact covering its appearance would indicate, for it is completely perforated with a multitude of minute holes or pores. When examined by the microscope, the shell has a sieve-like appearance, very much resembling the white perforated paper sold by stationers. By means of these holes there is a constant evaporation going on from the time it is laid until it is consumed. This evaporation depends upon the conditions under which the egg is kept, and will vary in accordance with these conditions, being much more rapid in hot weather than in cold, and in warm places than in cool. It is for this reason that eggs are not so easily kept in summer as in winter. If by any means this evaporating process can be stopped, and no other influence of an antagonistic nature be brought into play, the egg remains sound and good for a great length of time. The substance used to close the pores of the egg must not be soluble in watery fluids, or liable to be readily removed. By means of chemical agencies the holes on the shells of eggs can be closed or filled with lime placed in contact in solution, and the contents preserved sweet and good for months.*

Within the shell are two membranes or skins, the outer one of which adheres to the shell, and the inner one slightly to the outer. Towards the large end of the egg the two are separate, and this forms the air chamber. The white of the egg partly consists of albumin, and is a transparent liquid, free from smell when the egg is fresh, and tasteless. The albumin coagulates on the application of heat at 140°, and is insoluble in water. Chemical analysis has demonstrated that it is composed of carbon, oxygen, hydrogen, azote, phosphorus, and sulphur, in various proportions. A part of the oxygen and hydrogen evaporates during incubation, or when the egg gets stale. In the white there are three distinct and separate layers of albumin: the outer (a liquid), the second in which chalazæ terminate, and an inner layer. The chalazæ are two twisted cords of a more dense albuminous character, which have their origin in the outer albuminous membrane, and take the form of a spiral cord in the direction of the longer axis of the egg. They are well known to all eaters of eggs, and are the portions which cooks take out when beating an egg. They form a ligament by means of which the yolk remains suspended in the midst of the albumin, with the germ floating upwards, and encircled by the thin membrane known as a membrane of chalazæ.

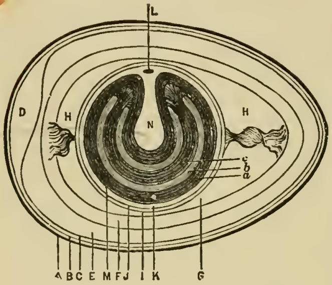


FIG. 18.—FORMATION OF THE EGG.

Section of an Egg.—*A*, the shell; *B*, membrane adhering to the shell; *C*, second membrane, slightly attached to *B*, except at large end of egg, where they separate and form *D*, the air-space; *E*, the white or albuminous part of the egg (first layer liquid); *F*, the white of the egg (second layer semi-liquid); *G*, the inner white; *H H*, chalazæ; *I*, outer membrane; *J*, very fine vitelline membrane; *K*. the outer part of yolk; *L*, germ; *M*, yolk; *N*, utricle; *a*, *b*, *c*, separate layers composing the yolk.

The yolk is the principal part of the egg, and is separated from

* *Journal of the Society of Arts*, December 9, 1887.

the white by a very thin enveloping membrane, called the vitelline membrane, and is slightly lighter than the white, filling the upper part of an egg when it is lying on its side. It is the yolk which ultimately furnishes nourishment for the embryo, and its composition is richer than that of the white. It comprises a layer of white yolk, which does not harden even in cooking, and within this are concentric layers of yellow and white, which curve round the utricle, the interior part of which contains the germinative vesicle. When the egg is perfect the vesicle touches the vitelline membrane, at the upper part of which is found the germ, known from its yellowish-white colour.

The yolk is composed of albuminous matters, of organic salts, of vitelline, of colouring matters (a red and a yellow), of phosphoric acid, and of a fatty phosphoric substance of itself sufficient to support the chick during its earlier stages.

Process of Production.—The process of production of an egg is a most interesting one. The ovum, or yolk, which, as we have already seen, contains the germ in a fertile egg, is generated in the ovary, and so soon as it ripens there is a rupture of the ligament by which it is attached to the ovary. Then, passing down the oviduct, it is first impregnated, coated with layers of albumin, has the chalazæ placed in their proper position, and finally receives the skins and outer shell. As may be easily imagined, this delicate organization is very easily thrown out of gear, more by overfeeding than anything else.

Eggs are produced from what may be termed surplus food, by which we mean such food as is not absolutely required for sustenance of the bird; and if food be given in excess or of too stimulating a nature, the result is, in the one case, that the organs are clogged up with fat, and the egg-laying machinery stopped, or, in the other, that the ovules are produced too rapidly. In the ordinary course of things only one ovum should be generated in twenty-four hours, and the fowl ought not to lay more than five or six times a week. If two ovules are produced in one day, many eccentricities are the result, which puzzle the poultry-keeper. Sometimes two of these pass into the oviduct together, and then a double-yolked egg is formed. If this egg is set and the yolks have been fertilized, then come some of those freaks of Nature which are communicated as great wonders. Occasionally two perfect chickens are developed and hatched out of one shell, but as a rule only one ovum comes to maturity, and thus we get four-legged or two-headed monstrosities. Another result of overfeeding is the production of one perfect egg within another. This is caused by an irritation of the oviduct, which, contracting in front of the perfectly-formed egg, instead of behind it, forces it back until it meets another yolk, when the two join company, and, again being coated with the white and the shell, produce the wonder spoken of. Soft eggs result from overfattening food and too little exercise, the ovum passing down the oviduct too rapidly for the secretions to be properly applied, or, on the other hand, they may be caused by absolute want of lime, without which, as we have already seen, the shell cannot be properly made. None of these irregularities are found in wild birds, and these must be regarded as a penalty of domestication.

There is a great variation in size of eggs laid by different breeds. Nor is this variation relative to the size of body, for many of the largest varieties produce comparatively small eggs, and *vice versa.* Speaking generally, there is little doubt but that on the whole the size of eggs, and the fecundity of our domestic fowls, have greatly increased within the last fifty years. Some varieties may have suffered in both respects, due to close breeding and attention to mere external qualities; but we have many other breeds that have more than taken their places.

Formation of the Chicken.—The conditions necessary to the development of a germ are chiefly heat and moisture. Given the presence of an embryo within a shell, if proper heat and a sufficiency of moisture are provided, with daily cooling and turning of the egg, these gradually cause development, which results in the appearance of a chicken at the end of twenty-one days. In order that the germ may receive heat, there is a most delicate and beautiful arrangement by which it floats ever to the top. This is secured by the chalazæ, which not only keep the yolk in its place, but weigh down the lower side of it, and however the egg is turned the germ floats at the top. It is for this reason that, in working an incubator, regular turning of eggs is insisted upon so strongly. When a hen is employed, she does the work herself; but if it is not done, there is danger that the heat will cause yolk and white to adhere, and as a consequence the embryo dies. Very many addled eggs are so caused by want of being properly turned.

As soon as the fertile egg is subjected to proper conditions, the germ therein at once begins to expand, and within twenty-four hours has very sensibly enlarged. The heat necessary to secure this is between 102° and 106°. Less than the former is not sufficient to bring the germ to maturity, though 100° would start it, and over 106° is most likely, if maintained for several hours, to kill it. Generally we have found that the best plan is to keep the heat as near 103° as possible. That will permit of a little variation without danger, and yet be sufficient to effectually mature the chick.

Fertile and Infertile Eggs.—A few words here as to infertile eggs will not be out of place to emphasize what has already been stated. By the term " infertile " is meant an egg that has never been impregnated, and consequently one that cannot possibly hatch, for it does not contain an active germ, and without this no amount of heat can develop a chick. The germ is present ere the egg is formed, and must be impregnated, and the contents are meant to be its source of nutrition, and the shell its protecting envelope. The effect of heat upon an egg is to dry up the contents and reduce them to a smaller compass. An infertile egg does not as a rule go rotten, a fact not generally known. Without death there can be no decay, and there cannot be death unless there has been life. Absence of a fertilizing germ means that the contents of the egg are inert and will not become rotten. The only exception to this is when an egg is produced by a diseased hen, or in which are bacteria. On the contrary, when there has been life, but this life has died, all the elements of decay are within the shell, and that which would have been its strength becomes its weakness. The dead embryo—or, if the chick has been more or less formed, the dead chick—begins to decay, and soon the whole contents are a mass of corruption. This fact needs explanation, as many persons have erroneous ideas thereon.

Position of the Germ Vesicle.—It is here to be noted that, when an egg is properly formed, the germ vesicle always remains on the upper side of the yolk, and at the mouth of the utricle. The reason for this is probably that it may more easily receive the heat necessary to its development. Turn an egg as we like, the germ will be on the upper side. This fact teaches us, as does the natural method of incubation, that the heat should be applied from above, not below. If the heat has to pass through the yolk as well as white, it will lose some of its power, and at the same time affect adversely the yolk.

Influence of the Yolk.—We must bear in mind the purpose for which an egg's yolk is intended—namely, to feed the chick during the period of its development. Or, as Marshall says: " The embryonic portion is formed from the part of the egg comparatively free from food-yolk, and becomes converted directly into the embryo, while the vitelline portion or yolk-sac, which contains the bulk of the food-yolk, does not give rise directly to any part of the embryo, but forms a store of nutriment at the expense of which the development of the embryo is effected. At first the embryonic portion is very much smaller than the vitelline portion or yolk-sac, but, inasmuch as the embryo grows by absorption of the food-yolk, the yolk-sac diminishes as the embryo increases in size. A time comes when the two are about equal in bulk, and in the later days of incubation the yolk-sac is much smaller than the embryo. By the twenty-first day of incubation the yolk-sac is almost completely absorbed."*

When a fertile egg has been laid, it will be found that the result of what is called segmentation—really a commencement of formation of the embryo due to the heat of the hen's body—has been to form a minute cap over the germ vesicle, on the under-side of which is a number of cells. These have no form indicative of their later use, but are very distinct, and under the microscope show various characters. So soon as sufficient heat is applied, the process, suspended in the meantime, resumes its operations.

First Day of Development.—During the first twenty-four hours the embryo develops those parts which afterwards form some of the leading organs of the body, notably the head, the vitelline vein, and neural fold and groove. But at this period it is not easy to distinguish between the embryo itself and the surrounding part, known as the area pellucida. Thus early in the period is formed the amnion, which may detain us briefly. This is a peculiar membrane enveloping the embryo, and forms a cavity in which this lies. It is made in folds, and "when the several folds meet and coalesce above the embryo, they unite in such a way that all their inner limbs go to form a continuous inner membrane or sac, and all their outer limbs go to form a similarly continuous outer membrane or sac. The inner membrane thus built up forms a completely closed sac round the body of the embryo, and is called the amniotic sac, or amnion proper, and the fluid which it afterwards contains is called the amniotic fluid, or *liquor amnii*. . . . The outer sac over the embryo lies close under the vitelline membrane, while its periphery is gradually extended over the yolk as the somatopleuric investment of the yolk-sac. It constitutes the false amnion, while the membrane of which it forms a part is frequently known as the *serous membrane*"† (Plate VII.).

* "Vertebrate Embryology," by A. Milnes Marshall, M.D., D.Sc., etc. London, 1893.

† "Elements of Embryology," by Foster and Balfour London, 1893.

Second Day.—During the second day the sections of the embryo begin to take a more definite form, and various organs commence to assume something of their ultimate shape. The head now becomes more prominent, and grows more rapidly than the remainder of the body, for during the earlier stages there is no relation in size between head and rest of the body, as will be the case later on and after hatching. Here should be mentioned that the embryo is firmer and more definite in type than was the case earlier on. Up to this point the head is straight, and it is not until later that it assumes the shape afterwards maintained.

It may be stated that between the twenty-fourth and twenty-third hours the front end of the neural canal dilates into a small bulb, whose cavity remains continuous with the rest of the canal. This bulb is known as the first cerebral vesicle, and makes its appearance in the early hours of the second day. From its sides the two optic vesicles grow out. Behind the first cerebral vesicle two others make their appearance very shortly after the first, and still farther back two shallow pits are to be seen, the auditory pits constituting the initial stages of the organ of hearing.

The heart is at the first really formed within the head-fold, where the throat will afterwards be found, though that organ has not yet appeared. The heart soon begins to beat, at first slowly and infrequently, but soon assuming more frequent pulsations. Connected with it are the veins, which will be more fully dealt with when we describe the vascular system, but it may be mentioned that during the latter half of the second day the blood begins to flow.

With further reference to the head and brain, Balfour states that " at the beginning of this (second) day the front end of the medullary canal was dilated into a bulb, the first cerebral vesicle, which by budding off two lateral vesicles became converted into three vesicles: a median one connected by short hollow stalks into a lateral one on either side. The lateral vesicles, known as the optic vesicles, have become converted into parts of the eyes; the median one still retains the name of the first cerebral vesicle." On examination, wrinkles are discerned in the head, which " vary a good deal in appearance, and shift from time to time, but eventually, before the close of the second day, after the formation of the optic vesicles, settle down into two constrictions, one separating the first cerebral vesicle from that part of the medullary canal which is immediately behind it, and the other separating this second portion from the third. So that instead of there being one cerebral vesicle only, as at the commencement of the second day, there is now, in addition to the optic vesicles, a series of three, one behind the other; a second and third cerebral vesicle have been added to the first." Towards the end of the second day the fore-brain, with its optic and cerebral vesicles, becomes slightly bent downwards, so as to form a rounded obtuse angle with the rest of the embryo. This is the head-fold, about which more will have to be said.

During the second day of a chick's development is found the first trace of the allantois, a temporary arrangement effecting most important functions during the period the embryo is within the shell, and assuming a more prominent form during the third day. It is part of the alimentary tract with which it opens immediately in front of the gut, which tract is formed by the primitive streak already referred to. "At first it is enclosed within the hind-gut, but on the fourth day begins to pass out beyond the body of the chick, and eventually spreads out over the whole body. On the first half of the fourth day the vesicle is still very small, and its growth is not very rapid. Its mesoblast wall still remains very thick. In the latter half of the day its growth becomes very rapid, and it forms a very conspicuous object in a chick of that date. At the same time its bloodvessels become important. It receives its supply of blood from two branches of the aorta, known as the allantoic arteries, and the blood is brought back from it by two allantoic veins, which run along in the body walls, and, after uniting into a single trunk, fall into the vitelline vein close behind the liver" (Balfour). By the ninth day the allantois has grown enormously, and has spread over the back of the embryo, and quite halfway round the interior of the eggshell. It lies close to the shell, and is the medium through which the respiration of the embryo is effected. On the twentieth day the allantois dries and shrivels up, and as the chick steps into the outer world it is cast off (Plate IX.).

Third Day.—It is usually recognized that the third day is the most important of all, in that so many of the new organs now begin to make their appearance. "On opening an egg on the third day, the first thing which attracts notice is the diminution of the white of the egg. This seems to be one of the consequences of the functional activity of the newly-established vascular area, whose bloodvessels are engaged either in directly absorbing the white, or, as is more probable, in absorbing the yolk, which is in turn replenished at the expense of the white. The absorption, once begun, goes on so actively that by the end of the day the decrease of the white is very striking" (Balfour).

It will be remembered that during the second day of develop-

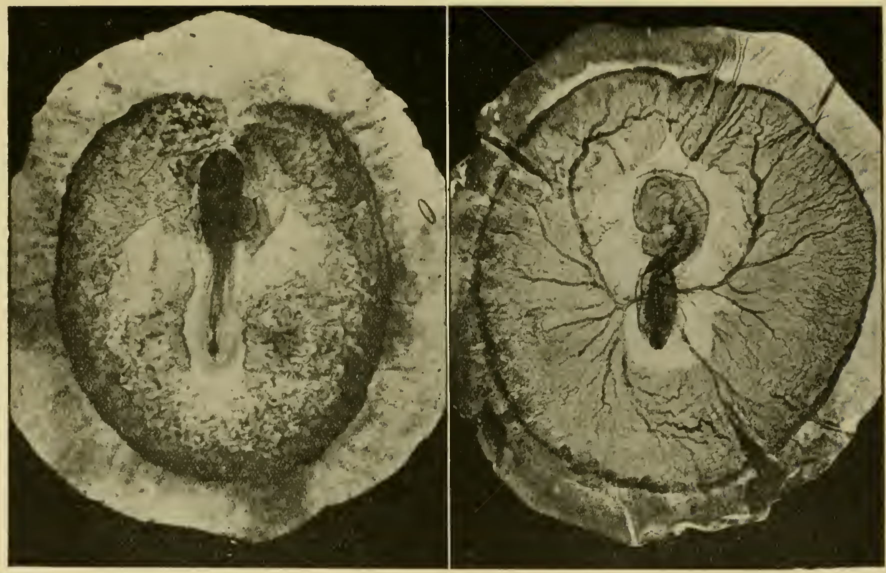
PLATE VII.

Photo] [C.E. Hearson

Embryo, Eighteen Hours. Embryo, Twenty-four Hours.

EMBRYONIC DEVELOPMENT OF THE CHICKEN.

PLATE VIII.



Photo] [C. E. Hearson.

EMBRYO, FORTY HOURS. EMBRYO, SEVENTY-TWO HOURS.

EMBRYONIC DEVELOPMENT OF THE CHICKEN.

ment we saw a commencement of the head-fold, and this change proceeds rapidly during the third day, by the end of which it is entirely folded over, the optic vesicles coming to the centre, as shown in Fig. 19, drawn from a series of excellent photographs from Nature, taken by Mr. Charles Hearson, of Regent Street, London, to whom I am indebted for this and others. At first they are comparatively small, but steadily increase in size, finally assuming the prominence and position to be retained during life. The shape assumed by the head has to be modified, for the brain-pan has yet to be filled, the beak and mouth to be formed, although the nostrils and ears are well established. The head is really the first part of the body to assume its shape,

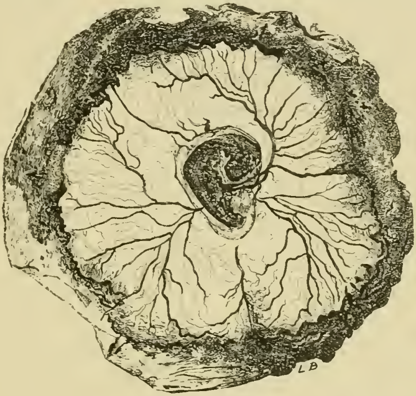


Fig. 19.—Embryo, Third Day.

and in the earlier stages is disproportionately large, as compared with the rest of the body. The formation of the eye is one of those wonderful processes so general in natural operations, in which the needs of the future animal are provided for by a multitude of marvellous growths and evolutions. To attempt a description of these would involve more space than can possibly be afforded.

The nostrils or organ of smell is found to appear during the third day, at first being two depressions in the under-surface of the head, immediately in front of the eyes. During the same period we find the alimentary canal forming with great rapidity, and this is to some extent connected with the tail-fold, in itself very similar to the head-fold, so far as the method of formation is concerned. Thus we have the initial stages of the digestive system. And also lungs, liver, and kidneys are found to grow, even though at first very diminutive. All this time—in fact, from an early period—the nerves are exerting a very important influence in the bird's structure.

Fourth Day.—Coming to the fourth day, and especially the latter portion of it, we find that there has been very rapid progress, an increase of size in the embryo being very manifest. At the same time the white of the egg has diminished still more, and the embryo is lying almost in immediate contact with the shell. The vascular area by this time is nearly an inch in diameter, and there is a great increase in the quantity of blood circulating through the veins. It is not necessary that we should say more respecting the head, other than to indicate that the various parts are quickly assuming a definite form. But the most striking feature to be noted is the growth of the body proper, from which the limbs begin to spring on the fourth day, though they can be very slightly traced towards the end of the third day. At first they are simply conical buds projecting outwards, covered with a sort of cap. The front-limbs are longer and narrower than the hind-limbs, which are comparatively short and broad. The vertebral column is now taking more definite form, but not until the fifth day do we find it anything like complete. And towards the end of this day is formed in the embryos of both sexes a duct, which in the female forms the oviduct, but is not needed in the male, and consequently disappears.

It is generally conceded that during the fourth day the generative organs also begin to appear, but as yet they are very indistinct, and not until a later period can their distinctive features be determined. Upon this point there is comparatively little real information. Apparently at first they are identical, and at this period are termed primordinal ovum, the first traces of the male organ being discernible about the sixth day. What are yet the influences towards the determination of sex do not yet enter within the range of exact science, and, being speculative, are outside our present purpose.

Fifth and Later Days.—By the fifth day "the limbs have increased, especially in length; in each a distinction is now apparent between the more cylindrical stalk and the flattened terminal expansion; and the cartilaginous precursors of the several bones have already become visible. The fore and hind limbs are still exceedingly alike, and in both the stalk is already beginning to

PLATE IX.

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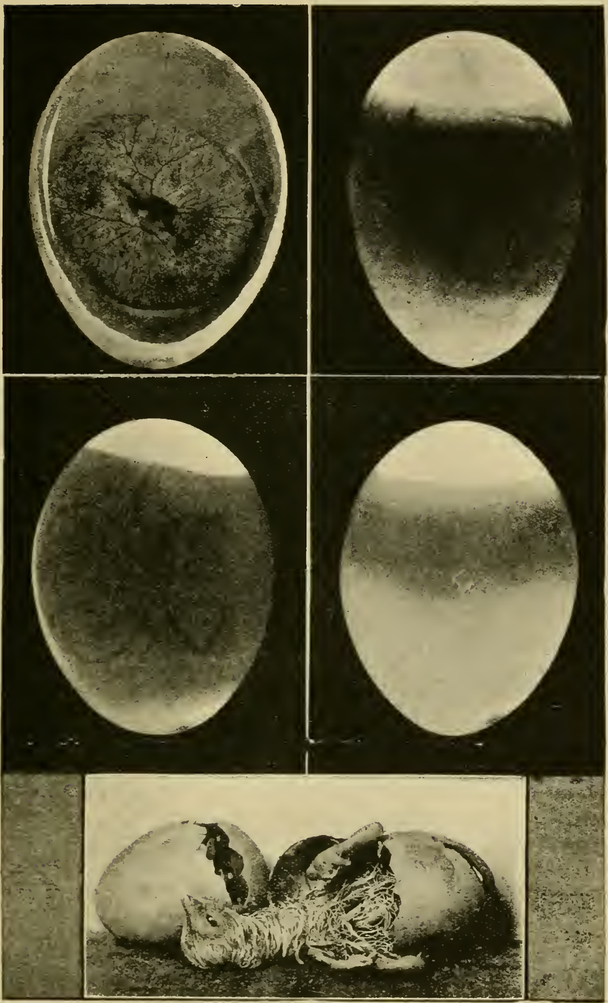


Photo] 5 [C. E. Hearson.

1. EMBRYO, FOURTH DAY, IN SITU. 2. FERTILE EGG, FOURTEENTH DAY. 3. FERTILE EGG, SEVENTH DAY. 4. INFERTILE INCUBATED EGG, FOURTEENTH DAY. 5. EXIT OF THE CHICKEN.

EMBRYONIC DEVELOPMENT OF THE CHICKEN.

be bent about the middle to form the elbow and knee respectively. The angles of both knee and elbow are in the first instance alike directed outwards and somewhat backwards. By the eighth day, however, the elbow has come directly backwards and the knee forwards. In consequence of this change the digits of the fore-limb point directly forwards, those of the hind-limb directly backwards. This state of things is altered by a subsequent rotation of the hand and foot on the arm and leg, so that by the tenth day the toes are directed straight forwards, and the digits of the wing backwards and somewhat ventralwards, the elbow and knee almost touching each other. . . . By the tenth day the fore and hind extremities, save for the absence of feathers and nails, are already veritable wings and feet" (Balfour).

The development of the chicken from the sixth day to its appearance from the shell does not require so much description, as it is to a large extent growth to proper size of the various organs. There are, however, various features which are of very great interest and deserve our study.

One of the proofs of the evolutionary theory is that embryos are so much alike in the earlier stages. Striking and numerous as are the features which render the class Aves one of the most easily recognizable in the whole animal kingdom, the embryo of a bird does not materially differ from that of a reptile or a mammal, even in the points of structure which are most distinctly avian. It may, it is true, be possible to infer, even at a comparatively early stage, from some subsidiary tokens, whether any given embryo belongs to this class or that (and, indeed, the same inference may be drawn from the ovum itself), but up to a certain date it is impossible to point out in the embryo of a fowl the presence of features which may be taken as broadly characteristic of an avian organization. This absence of any distinctive avian differentiation lasts in the chick, roughly speaking, till the commencement of the sixth day. We do not mean that on the sixth day all the organs suddenly commence to exhibit peculiarities which mark them as avian.

There are no strongly-marked breaks in the history of development; its course is perfectly gradual, and one stage passes continuously into the next. The sixth and seventh days, however, mark the commencement of the period in which the specialization of the bird begins to be apparent. Then for the first time lighter-shaded lines below indicate all that is left of the white. By this time the body walls are definitely formed, and rudiments of the feathers are already present. "The head is still disproportionately large, and the eyes are of enormous size. The beak, which was absent in the earlier stages, has now grown out from the front of the face, and at once gives the head a distinctly avian appearance. The neck is long and slender. The body is much more bulky than before, largely owing to the great size of the heart and liver. The limbs have greatly increased in length, their several segments are well established, and the division of the distal ends into fingers and toes is very evident. The white of the egg has disappeared, a thick and very viscid mass alone remaining at the lower surface of the egg. The yolk-sac is still large, but its walls are flabby owing to the absorption of a large part of its contents as food by the embryo" (Marshall).

From this time onwards the principal business of the chick, for such it may now be termed, is to grow, and it only remains necessary to indicate a few of the changes which take place, bringing about the distinctive type of the species and variety.

As already seen, the feathers begin to appear on the ninth day. Then the sacs in which they are contained commence to force their way through the skin, and by the thirteenth day these are found all over the body, to the length of $\frac{1}{4}$ inch, and can be recognized as feathers by the naked eye. They, however, remain in the sacs until hatching, when these sheaths burst and are thrown off.

On the eighth day the beak begins to show itself, first as a chalky-looking mass, which by the twelfth day has developed into a horny beak, though still soft. It is not until the thirteenth day that the nails take their form, and by the sixteenth day these, together with the beak, harden considerably.

About the sixth day movements can be discerned in the embryo, but these are comparatively slight until the fourteenth day, for it retains the same position all this time—namely, the body is at right angles to the long axis of the egg. At the period named a definite change of position is to be noted, for the bird now moves so that it lies lengthwise in the egg, its beak touching the inner shell membrane, the air-space at the broad end having greatly increased in size. This is the position a chick must occupy in order to make its way out of the shell, for if not so placed we shall have a false presentation, and probably inability on the part of the chick to make its way out.

By the twentieth day the chick has grown so as to fill all the shell except the air-space. The position is very beautifully shown by Fig. 20, drawn after Nature, and from which the shell and membrane have been removed. By this time the yolk has been almost entirely absorbed, and what remains in the sac is drawn into the body, the walls closing over it at the umbilicus.

This yolk serves to supply the chick's need for two to three days after hatching, for Nature always provides in this manner for the first separate existence on the part of its creatures.

Process of Hatching.—We have only now to describe the actual process of hatching. When ready for this work, the chick has only to lift its head and pierce the inner shell membrane, which it can easily accomplish under normal conditions, when it at once commences to breathe the air contained in the chamber. The doing so causes the pulmonary circulation to become functionally active, and the blood now ceases to flow through the umbilical arteries. As a result the allantois shrivels up, its purpose having been served. The head is lifted into the air chamber, and the chick has now room to deal blows upon the

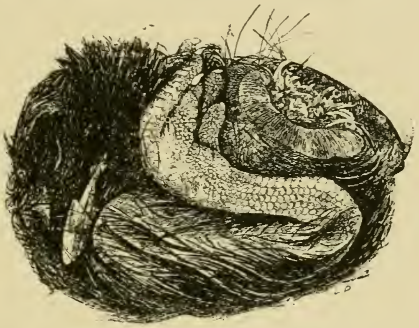


FIG. 20.—CHICKEN IN SHELL (IMMEDIATELY BEFORE HATCHING).

shell, which repeated upon the same place result in fracture of the shell. Turning round a little, this process is repeated, and so on until the shell is broken round about one-third from the broad end. When completed, by pressing its head against the broad end and its feet against the other portion, it is enabled to throw off the shell, and so it steps out into the world (Plate IX., 5).

Briefly stated, we have here the process of development; but whilst we can observe and describe many of the processes taking place within the shell, the mystery of life itself, as of the influences which give us the great divergences of type in our fowls, are still among the great secrets of Nature, who seems to say, and in no hesitating manner, "Thus far shalt thou go, and no farther." We may speculate in this direction, but of positive knowledge there is comparatively little.

CHAPTER XV

HATCHING, NATURAL AND ARTIFICIAL

In the setting of hens there are many essentials to success. I do not mean that unless these are observed hatching is impossible, for eggs will frequently hatch under the most untoward conditions and in spite of most disadvantageous circumstances. Such a state of affairs cannot be reckoned upon. The first essential to success is vigour and stamina of the stock birds. The dangers of inbreeding have already been pointed out, and one of the most frequent results is that large numbers of the eggs produced are infertile, or become addled, or die during the early stages after hatching. Many instances could be cited in proof of this contention. Vigour of stock is absolutely necessary if the progeny are to be healthy and strong, and we require strong, healthy, untainted birds upon good runs. Conditional influences are also important. Without parental vigour all efforts will be in vain. Eggs with strong germs hatch better, even where the conditions are less favourable, than those where every influence is helpful, but the parents are weaker in constitution.

Elements in Hatching.—Heat, moisture, and oxygen appear to be the factors at work in the production of chickens from eggs. Heat is, of course, supplied by the hen, who also, if she be a good sitter, will see to the cooling, though as a rule it is better not to trust entirely to her for this. Moisture is beyond her control if the place of sitting is allotted to her. In some districts there is no trouble whatever on this score, as the atmosphere is naturally and sufficiently saturated for the requirements of eggs. In others great care has to be taken, or dryness of the atmosphere will be fatal to successful hatching. Seasons also differ. A dry spring will demand more attention to the question of moisture than a moist one, and thus the poultry-keeper has to use his brains if he wishes to be successful. There is another influence which must be referred to, as it is a most important one to all those whose places are subject to cold easterly winds. It needs no description to impress this fact upon most poultry-keepers. What is the influence of east winds upon our fowls and their eggs has never been satisfactorily explained, but eggs are less fertile, fertile eggs are very likely to be addled, and hens often go on strike, unless they are set in places much more comfortable than fall to the lot of the majority of human beings. That explains why some seasons are unsatisfactory. Here, again, vigour in the parents is of supreme importance.

Places for Sitters.—Where only two or three batches of eggs are to be hatched during the season, there need not be much difficulty in providing for them. A hen can be set in some quiet outhouse or shed, where the work will probably go on without any hindrance. In this case, if the house or shed can be given up to the hen entirely, it will only be necessary to provide a square box without a bottom, which, standing either upon the earth, if its floor be of that material, or upon sand or earth, if it has an artificial floor, will be the simplest arrangement. This box should be made to completely cover the hen, but without a front, so that she can leave the nest whenever she wishes so to do. If it is thought desirable, such a box can be used with a door in front, so that, if necessity should arise, the hen can be enclosed. The form of hatching box commended is without bottom (Fig. 21), and for ordinary-sized fowls is made about 15 inches square, and 18 or 20 inches high. The material (wood, of course) is ½ or ¾ inch boards, and it is built with solid back, sides, and top. The upper part of the front forms the door, which is the width of the box, and 15 inches high. A piece of deal 3 or 4 inches in depth, according to the height of the box, forms the lower section of this front, or, if a 20-inch-high box, the bottom piece may be 3 inches, and a similar lath, 2 inches wide, fixed at the top of the front. The loose portion is made the door, and is hinged at the bottom, fastening to the top by a button. When the door is open it falls downwards, and thus provides a firm footing for the hen in entering or leaving the nest. Three ventilation

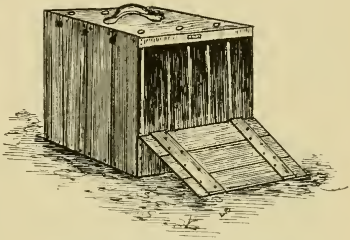


Fig. 21.—Close Hatching Box.

holes should be made in each of the sides and back quite close to the top, a row about 4 inches from the bottom, and half a

Fig. 22.—Double Hatching Box with Lids.

dozen in the top, to which a handle can be fitted. They are specially needed if there is a door to the box. Wire netting may be stretched across the bottom as a protection against rats,

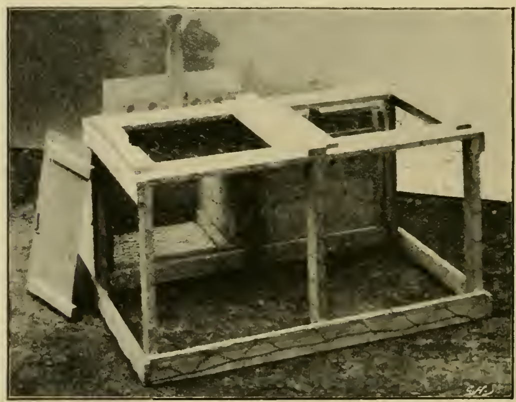


Fig. 23.—Double Hatching Box.

which is a very necessary precaution where these pests are troublesome. Fig. 22 shows a double box with lids, specially for use in hatching-rooms. Such boxes can be used anywhere whether one or a score hens are set in the same place, and they can also be utilized as laying boxes when the hatching season is over.

Where only a few hens are to be set, we should advise that later in the season (except in unusually cold weather)—say after the early part of April—the hens have their nests made out in the open. Some shelter will be necessary, but if one of the hatching boxes be used, all that will be required is either a rough covering or a coop, or the hen can be set in a coop, and then will not need to be disturbed when her chickens come out. On farms there are often sheds scattered about which can also be utilized. One of the difficulties of this plan—at least, in many parts of England—is that foxes are preserved. A capital arrangement in such districts is a double sitting box (Fig. 23) with runs.

Hatching-Rooms.—By the expenditure of a little trouble, arrangements can be made by which a large number of hens can be set in a single room. In selecting a room for the purpose of sitting hens, it is desirable to have one as little subject to variations of temperature as possible, for there is then much less danger from sudden frosts. It must be clean and sweet. If the atmosphere is somewhat moist, it will be none the worse, moisture being a most important element in hatching operations. Then, again, if it is rather dark hens will sit all the better; but in any case the sitting-room should be darkened, if it is not already sufficiently so. The thing to avoid most of all is a hot, dry place, for there it will be almost impossible to succeed in hatching operations. The plan I have adopted, and with the greatest success, is to place several of the hatching boxes already described in a special house, with their backs to and about a foot from the walls. In a room 15 feet square sixteen or eighteen of the hatching boxes can be accommodated, and I have had as many as twenty at one time. Each box should be at least 6 inches removed from its neighbour, so that there may be a free current of air all round, for air is a most important factor in the hatching of eggs. Thousands of eggs are addled, or the chickens asphyxiated, by foul air with which they are surrounded, and which the chicken, if it can be so termed at that early stage, within the shell, is thus compelled to breathe. There should be a layer of fine earth—say 6 or 7 inches thick—on the floor, upon which the hatching boxes are to be placed. This layer is better if continued entirely around the room, and in no case should it be merely enough for the box to stand upon. The reason for this will be explained afterwards. It will thus be seen that, when the boxes are all placed in position, the doors will face towards the centre, for it is necessary to have doors on, or lids to, the hatching boxes when this plan is followed.

The form of hatching house illustrated in Fig. 24 is French in idea, and can be confidently recommended. It consists of a

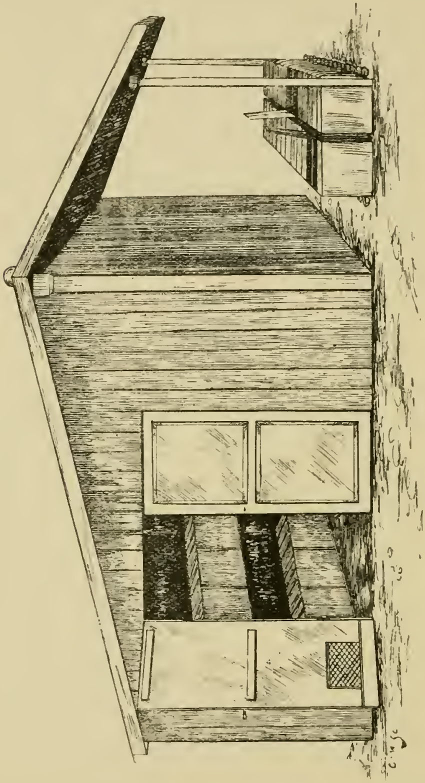


Fig. 24.—Hatching House.

shed fitted with sitting boxes in two tiers. These boxes differ from those already described, in that they have lids on top, and the hens are lifted off the nest. Outside the house is a covered shed, where the feeding cages are placed, as described in the next paragraph.

Outside Feeding Cages.—An excellent arrangement (Fig. 25), which has proved most effective, simplifies the work where a large number of hens are sitting at one time. As a rule in France baskets are employed with lids on top, and the nests made in much the same way as already recommended. Outside the hatching-room, under a shed, is a row of half a dozen square coops with barred fronts. Every day each hen is placed in one of these coops for about half an hour, in order to feed and dust herself, during which time the basket or the hamper is left open so that the eggs may be cooled. The floor of the coop is thickly covered with fine dry earth or ashes, which the fowls enjoy and thus rid themselves of parasites. If six hens be fed at the same time, and each one be removed to the feeding cages in rotation, there is no danger of returning them to the wrong nest. We may here mention that a mistake is made in not cooling eggs sufficiently. Later observations have shown that, with a room

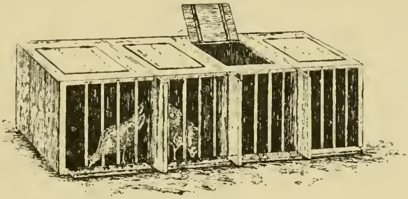


Fig. 25.—Feeding Cages for Sitters.

temperature above 45°, an hour is not too long after the first week. More harm is done by under than over cooling, for there is much truth in the old saying, "A close sitter is a bad sitter."

Making the Nests.—In making the nests within the boxes, a shovelful of earth or ashes is first placed therein, and then hollowed out into saucer shape, taking care that all the corners are filled, lest any of the eggs roll there and be chilled. There are breeders who use damp grass sods, but, as the object of both earth and sods is to give that cool dampness which is so essential to successful hatching, earth is to be preferred, as it can be made to fill up the box better. Upon this earth a nest is made of fine straw, oaten preferred, and which is all the better if well beaten or rubbed in the hands before being placed in the nest. When completed, the nest should be slightly below the level of the cross-piece at the front. The eggs should have no tendency to roll out, but always strongly incline to the centre of the nest. As a rule, when eggs are placed in a hatching box, and a broody hen put down before it, she will go on at once of her own accord. Sometimes, however, that is not so. A desirable plan, therefore, in setting hens, when they are put to a strange nest, is to let them have a few addled or dummy eggs at first. This is to prevent valuable eggs being wasted. When boxes with lids are employed, the hens must be placed on the nest.

Cooling and Feeding.—If there are twelve or fifteen hens sitting at one time, and all these have to be liberated for feeding and dusting separately, it will be seen that the attention of someone will be pretty fully taken up. The hens must be allowed out daily, and they cannot be let out together, or there will be conflict, resulting in general disaster. That can be obviated by the plan already recommended. If the time of an attendant can be given to the sitting hens, a simple way is to open the door of each box in turn, give the hen half an hour, then close her in, and open the next. Should any not have come off, they must be lifted, both for their own sakes and the cooling of eggs. The earth or ashes below the box will provide much of the moistness needed by the eggs; but in a very dry place, or during dry weather, it is desirable to keep the earth moist by pouring on it, around the box, a pint of hot water daily. This is much to be preferred to moistening eggs themselves, a plan which does more harm than good. Nests should be examined every day. When a hen has to be lifted off, as where lidded boxes are used, it is necessary to exercise very great care in doing it, to avoid breaking any eggs. Hens usually tuck the eggs tightly under their wings, especially when disturbed; and if a hen be lifted up bodily, the chances are all in favour of an egg dropping down upon others in the nest and making a general smash. Sometimes an egg is accidentally broken, and the contents adhere to her breast and to the shells of eggs remaining in the nest. If this be the case, a further breakage is certain to result unless the matter be put right. Should a hen foul her nest, which should never take place if she is let out at regular periods, the same result may accrue. It is to prevent this kind of thing that we advocate daily examination of nests. And as it is desirable not to allow a hen to be disturbed more than is necessary, that should take place at the time of feeding.

Hens should be fed on hard grain, such as wheat, or barley, or oats. They should be provided with fresh water daily, and have a good dust bath.

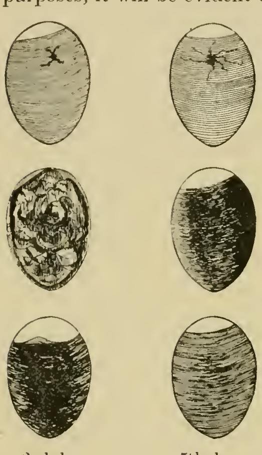
Hatching by Turkeys.—In some parts of France large numbers of chickens are hatched under turkeys, and the same plan has been tried successfully in this country. Should a hen turkey become broody in her first year, when it is inadvisable to breed from her, she may be usefully employed in this manner. Not only will she cover twice the number of eggs and brood three times the number of chickens that can be given to an ordinary hen, but she is most reliable, is less affected by weather, and ready when called upon at three or four days' notice. Moreover, the male birds can be used in this way as well as the females.

Choice of Eggs for Hatching.—Selection of eggs to be used for hatching purposes does not usually receive the attention which its importance demands. Given that such selection has been from birds mated specially for reproductive values, the eggs themselves must be carefully chosen. Those that are abnormal in size, whether over or under the average, in shape, or shell formation, should be rejected. What we have to seek for is a strong-shelled, well-shaped egg, which may be slightly above the average in size, as there is always present the tendency towards recession to the normal in the last-named direction. It is undoubtedly true that the size of egg has little actual correlation to the ultimate size of body of the chicken from it. Many of the breeds which produce large eggs are small-bodied, and *vice versa*. At the same time, size of egg for marketing is an important factor in the realizable values. If undersized eggs are selected for hatching, we are breeding from the hens that lay these, and passing on to the next generation the same tendency. By selection the size of egg can be materially improved in a few generations, and small eggs be eliminated. At the same time this must be done gradually and with judgment. Eggs which are much larger than the average of the breed are often infertile, and in any case are weaker than those conforming to the usual standard. Eggs should also be used as fresh as possible. If held even for a few days, they should be kept in a cool place.

Register of Hatching.—It is an excellent plan to have a book containing a register of the hatching operations, so that records can be kept for reference, both present and future. Each sitting box should have attached to it a card or label, easily seen by the attendant. The following is a simple form for the purpose:

Breeds of eggs .. ..
Date set .. ..
Date to hatch .. ..
Number of eggs .. ..
Number fertile on seventh day .. ..
Eggs broken .. ..
Chickens hatched .. ..
Remarks .. ..

Testing the Eggs.—At one time many poultry-keepers had a divided objection to interfering with the eggs during the time of sitting. That has been shown to be a sentimental objection, for there are very many advantages in testing them. When hens are doing the work, or the eggs are in incubators, the eggs should be tested during the process. This is preferably on the seventh day, and then by candle or lamp light. The object of this test is to see how many of the eggs are fertile, so that those that are clear can be taken away; and as they are still good for culinary purposes, it will be evident on that account alone there is a very strong argument in favour of the system. In large establishments some hundreds of eggs can be saved every year in this manner, which will represent a respectable item in the year's returns. There is another and still more important argument in its favour—namely, the space occupied by these useless eggs can be filled up, and the work either of hen or machine be used for such eggs as are of real value for hatching purposes. For instance, if three hens are set at one time—and two or three should always be set together—and on the first examination it is found that one-third of the eggs are infertile, when the useless ones are removed there will be just sufficient for two hens, and the third hen can be set again with a fresh batch of eggs. The fact is that this test enables, as a rule, as many chicks to be hatched with two-thirds the number of hens which would be needed under the other system. Coming to the method of examination, Fig. 26 represents external appearance of eggs when tested by light during the process of development. First remove all eggs from the nest, either when the hen is feeding or after lifting her off for the purpose, and hold them between a candle or lamp and the eye. The best time to do this is at night, and a candle or lamp can be placed at a convenient height for the purpose. Then take an egg in the left hand, holding it between the forefinger and thumb, using the other fingers of the



2nd day. 5th day.
8th day. 11th day.
19th day. Infertile or addled egg.

FIG. 26.—APPEARANCE THROUGH SHELL DURING INCUBATION.

hand as a shade to keep the light from the eye. The right hand is next put around the part of the egg left exposed, and the fingers of that hand used also as a shade (Fig. 27). The object is to only permit the light to be seen by the eye through the body of the egg, and a very little practice will enable anyone to hold it properly. Some use black cardboard, cutting in it an oval hole scarcely so large as the egg; and there are also egg-testers sold at about a shilling each, made of tin covered partially with black cloth. These are perhaps the simplest, though we have always been able to test much more quickly when using only the hands, as already described. In Fig. 28 is shown a powerful testing lamp, by which the germ can be distinguished at forty-eight to sixty hours. When the egg is fertile, the appearances will be seen as in Fig. 26. In this way we can tell whether the egg is fertile. If infertile, it is clear to the end, no matter how long it is sat upon.

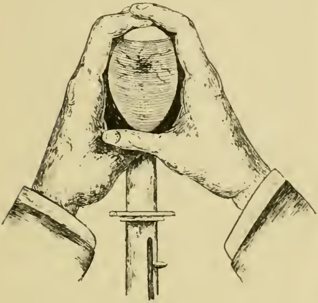


Fig. 27.—How to test an Egg by Candlelight.

Fig. 28.—Testing Lamp.

Incubators and their Use.—Artificial incubation has fascinated many minds for several centuries, and those who object to the adoption of this system may perhaps be surprised to learn that for nearly 2,000 years artificial hatching and rearing have been followed in Egypt, China, and other countries. The Egyptian egg ovens offer the most striking example of what can be carried out in the modification of natural methods. It has been stated that there are at the present time in Lower Egypt several hundred of these hatching establishments, in some cases with a capacity of 40,000 eggs at one time. No useful purpose would be served in giving a description of these ovens, which are evidently of a most primitive character, and depend upon the skill of the operator to a remarkable extent. The operators are members of families who have carried on the work for centuries, and hire themselves out to the proprietors for the hatching season. In the ovens no effort seems to be put forward to secure ventilation or regulation of temperature, and heat is engendered by the burning of dried camel dung on shelves above the eggs, the latter being placed in heaps upon the floors. I have endeavoured from time to time to obtain some reliable figures as to the percentage of hatching, but without success. In one case, however, I was informed that the loss of eggs by death in shell is enormous, amounting frequently to as much as 60 per cent.

The first records with which we are familiar as to any attempts in Western Europe are contained in a work written by M. de Réaumur, of the Royal Academy of Sciences in Paris, the English edition of which was published in 1750. M. de Réaumur tried many methods, including the Chinese system of hatching by means of dung, obtaining the necessary heat from decomposition of that material. The results were not encouraging. During the last century many attempts were made in this direction. At the first great International Exhibition in 1851 an incubator was exhibited, made by M. Cantello, and which commanded a large amount of attention. It was on a large scale, and the inventor, believing that the heat was communicated to the eggs by actual contact of the hen, used india-rubber on the lower side of the tank, resting it upon the eggs. The machine did not command any amount of success, and soon passed into oblivion. Many other attempts were made. The first I had personal experience with was the "Boyle" incubator in 1877—a most ingenious machine, but far too intricate and expensive. A little later a smaller machine was patented on the Cantello principle, but from want of an efficient method of regulation, in which the "Boyle" was almost perfect, and from the fact that large numbers of the chicks hatched were crushed by the weight of the water and the sagging of the india-rubber, it did not succeed. These and other machines were far too intricate, cumbersome, and costly, and it was not until the year 1878, when M. Rouiller, Principal of the French School of Aviculture at Gambais, introduced his hydro-incubator, that this system of hatching became at all practical. The machine named, which is still used in a modified form to some extent in France, had no lamp or regulator, the heat being maintained by the removal of a portion of the water in the tank every twelve hours, and the substitution of a relative quantity of boiling water. Although under these conditions fine regulation was impossible, I hatched very successfully with it. The trouble involved, however, was considerable. Modifications of this machine were made, but it is not too much to say that the introduction of the " Hearson " incubator in 1883 made the adoption of the system possible to a degree not known previously. Mr. Hearson's invention, which is fully described later, was in all respects a remarkable advance upon anything that had gone before, and brought the system within the compass of poultry-keepers of every grade. To the gentleman named poultry-keepers in all parts of the world owe a great debt, and his invention has extended the opportunities of poultry-keepers to a degree never yet fully recognized.

Are Incubators Practical ?—Within the past few years the increase of artificial methods of hatching and rearing chickens has been enormous. When incubators were first brought out they were very unreliable, but the experience gained, and the increase of knowledge as to the opportunities underlying this system, have led to a realization of the importance of hatching by other than the natural methods. Much of the increase of use, however, is due to the undoubted growth of the poultry industry in this country, to which artificial hatching has contributed, and it has been found again and again that those who were more progressive and adopted the newer methods succeeded where others had failed. Thus the laggards have been compelled in self-defence to follow in their footsteps. The use of incubators at one time was practically confined to fanciers and amateurs, and to a few of those who kept poultry for profit, but this is no longer the case. Instead of being a fad on the part of the few, artificial hatching is now a practical necessity.

The great advantage offered by incubators is the increase of power on the part of the breeder. Instead of being limited in his hatching by the vagaries or natural instincts of his hens, he is now in a position to hatch at almost any season of the year. One of the results of our breeding during the past twenty years has been to reduce the supply of broody hens, owing to the development of egg production. This in itself is partially the result of the introduction of artificial methods, because breeders dare not have bred for egg production to the same extent if they had been compelled to depend upon hens alone. The use of incubators has been enormously increased from this fact, and also the wide dissemination of the non-sitting varieties. To use an American expression, there can be no question that incubators "have come to stay," and it is difficult to realize what our position would have been without them. Nor are incubators used in isolated instances, and many of those who read these pages would be surprised to find the number of machines which may be at work upon one place. Poultry breeders with six to ten incubators are common, and there are a few instances where from twenty to a hundred are now in use at one establishment.

Use of Incubators.—Believing that the future of the poultry industry in this country largely depends upon the adoption of artificial methods of hatching and rearing, it is desirable to indicate the reasons for that opinion. The irregularity of hens at other than the ordinary season has been a frequent complaint. Not only are these uncertain as to when they will become broody, but there is always an amount of risk that, should the weather become suddenly colder, they may desert the eggs, which is a very serious matter early in the season and with valuable eggs. Moreover, every hen has to lay a number of eggs before she evinces any signs of broodiness, and these may be more valuable as potential chickens than for marketing purposes. It is impossible to use them unless other hens are available or we have an incubator. By machines we can hatch at any season of the year when fertile eggs are to be obtained, which is an important consideration for early chickens and for pullets intended to lay the following winter. A further recommendation is that with the great increase of non-sitting varieties of poultry, and the gradual elimination of those breeds which set early and often, breeders are finding sitters scarcer every year; many of the most popular varieties, even though they are sitters, by reason of having been bred to develop production, are comparatively late in becoming broody. We do not desire, however, to dethrone the hen from her position. The better plan is to use both systems. Until hens are ready to commence work we must depend upon incubators; so soon as they show the instinct, then it is desirable to take advantage of it.

Limitations of Artificial Methods.—At the same time, necessary though artificial methods are, and acknowledging the vast improvements made in these machines, the fact has become evident that these are second-best, and that there is something in Nature's own way which no machine invented has been able to supply. Whether this problem will ultimately be resolved it is impossible to suggest. Careful observations over a very long period, and extended experience in many countries, have made that fact evident. In some cases the mortality in incubator chickens has been enormous. I do not attribute that to the use of incubators alone, but to a combination of influences. In fact, I am inclined to the opinion that machine hatching has been responsible to the smaller extent. In many instances those who have used incubators, in addition have kept the breeding stock within confined areas, have bred almost entirely from pullets, and fed upon forcing lines, often using closely related birds, all of which have made for degeneracy, although the final bad results are unfairly attributed to the incubator alone.

The question is therefore a very serious one. In experience I have found that, taking a whole season's operations, which is the real test, the percentage of chickens hatched was higher under hens than with incubators, and that the chickens, when reared for stock or laying purposes, have greater constitutional vigour. All that we have been able to learn and do has not enabled us to reach the natural standard. Incubators are an absolute necessity, but their position is to supplement, not take the place of, hens. Wherever and whenever possible, the latter should be employed for production of breeding stock, leaving the machines to hatch layers and table chickens or ducklings, in which directions the opportunities are greater than ever. I do not suggest than an incubator may not be employed, say, for bringing out early birds. It is their persistent use year after year that is to be avoided in the breeding of stock birds.

Hen Oil.—A theory has been advanced of late that chickens hatched by artificial methods lack something which is imparted to the egg by the hen, and the fact is cited in support—which must be obvious to all observant poultry-keepers—that the shells of eggs under hens are coated with a very fine film of oil. The suggestion made is that this oil imparts a degree of vigour to the chick which cannot be obtained when artificial methods are employed, or that it prevents evaporation. Such a suggestion has met with a considerable amount of opposition. Discussing this question with the late M. Van der Snickt of Brussels, he informed me that in Belgium the reason why artificial methods of hatching had not in many cases been adopted by the peasants in some districts, is that they strongly hold the opinion here expressed. He stated that it is a common practice on the part of Belgian peasants to kill an old hen and to rub the eggs over with part of her fat, even when these are to be covered by hens. Upon this point, however, we have no definite information, and cannot do more than simply mention the theory as put forward.

Incubator Houses.—The increase of artificial incubators has developed the need for arrangements, where this work is carried out upon a large scale, suited to those conditions. In many places, where only one incubator is used, it is not at all difficult to provide that the machine shall be kept quiet and supplied with the attention and management it requires. If we multiply the number considerably, it then becomes necessary to make other arrangements. It is easily understood that, if only one incubator is at work in a room, the amount of influence upon the atmosphere by the burning of an oil-lamp for maintaining the temperature would be comparatively small; but if there were a dozen incubators, the exhaustion of oxygen would be very rapid indeed. Hence experience has shown that, unless great care is taken in this direction, there is danger of the results being less satisfactory when operations are upon the larger scale. That is so, however, in all departments of life; what can be done on a small scale does not necessarily follow when the amount of work accomplished is greatly increased. In America, poultry breeders have of recent years largely adopted the system of incubator cellars, as they are called, the greater part of which is underground, but that system has not been found necessary in our own country. We must bear in mind that in America the winters are very much colder and the summers hotter than with us, and these incubator cellars have been devised specially to counteract the extremes in one direction or the other. There can be no question that for one or two machines, and in the absence of a special house, a cool, sweet cellar is one of the best places for incubator work, by reason of the fact that it is cooler in summer and warmer in winter than an ordinary building above-ground. In many cases, unless they are specially built, ventilation is bad, and there is frequently a close smell which betokens impurity of atmosphere.

I have been much surprised in visiting some poultry plants to note the disregard of efficient ventilation, and that the object is to crowd as many machines as possible into a given space, both of which conduce to failure. Eggs containing living embryos all the time are practically breathing, certainly after the first week. A constant circulation of air is required to carry from the egg the gases formed, and to replace these by oxygen, which can only be if the atmosphere is pure and abundant. Overcrowding involves denial of suitable conditions, and want of efficient ventilation lack of what is the most important element. In our incubator house (Fig. 29) we allowed 2 cubic feet of air-space for every egg undergoing the process, and that is the minimum, combined with a constant circulation of fresh air, in the direction of successful operation. In this country an above-ground building is to be preferred for larger incubator houses, and in these ventilation is much easier of accomplishment.

In this connection I describe an incubator house which was used most successfully. The accommodation in the house was for twelve incubators, although there was sufficient room to place other four should they be required. The house (Fig. 29) was 32 feet in length by 16 feet in width, divided into two sections, one 27 feet by 16 feet, and the outer room or porch 5 feet by 16 feet. The whole stood upon concrete foundations, with a floor of Staffordshire tiles, so that it was solid and firm. The walls were 8 feet 6 inches in height at the eaves, rising to 11 feet at the apex of the gable, and the walls made of double boarding, the wood employed being red deal an inch in thickness, and well put together. Between there was a lining of felt. The roof consisted first of inch boarding, upon which was laid felt, and covered finally with corrugated iron. It will be seen that the substantial character of the building had the effect of making the incubator-room less subject to outside atmospheric influences than would be the case if the walls and roof were built of lighter material. Fig. 31 shows the ground-plan of shed.

In a building of this kind the consumption of oxygen in the atmosphere when twelve lamps are burning, and also to supply the 1,200 eggs—which was the capacity of the machines at work—must be very considerable, and, after careful consideration of this question, a system of ventilation was adopted which was a novelty. Outside were eight 3-inch pipes, their terminals 5 feet above the ground, as shown in the illustration. These were carried down outside to within a foot of the floor, and then entered the building, the air passing through regulating gratings inside, so that the current could be controlled. The object of bringing the air in below the level of the machines was in order that, as it ascended, such as was required for the eggs could pass directly into the incubators without being contaminated by the lamps, whilst at the same time the lamps themselves were supplied with perfectly fresh air. In the apex of the gables we had large regulating ventilators, so that the air entering a little above the floor was drawn upwards to the lamps and the machines, and then passed out above. This method of ventilation proved an unqualified success. During warmer weather more air could be given by opening the windows. It may be explained that these windows—of which there were four—were all on the east side of the house. Under no circumstances should windows in incubator sheds be on the south side, or even on the west, because during the hotter months of the year that would raise the

FIG. 29.—INCUBATOR HOUSE, COLLEGE POULTRY FARM, THEALE.

temperature of the room to a very large extent. In order to provide against excessive heat, this incubator house was placed under the shade of a very large walnut-tree, keeping it cool in summer.

As already explained, the building was divided into two parts —namely, the larger room for the incubators themselves (Fig. 30);

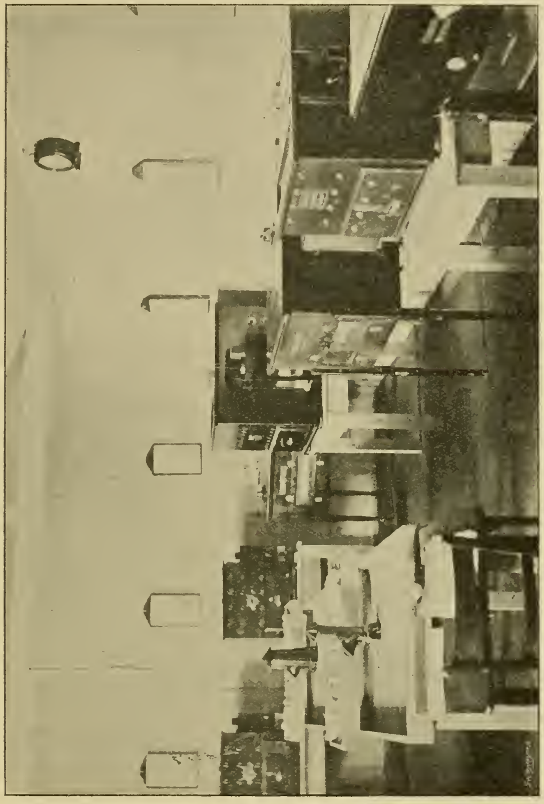


Fig. 30.—Incubator-Room, College Poultry Farm, Theale.

and the outer room, where the stores were kept and the lamps were cleaned. This outer room was fitted with cupboards, the tops of which were covered with lead, for cleaning and refilling the lamps, and thus there was no danger of oil being spilled near the incubators. Large double doors opened from the outside, first into the small room, and from there into the incubator-room. Inside were tables for cooling and testing the eggs. These were fitted with flanges, so that as the eggs were tested they could be

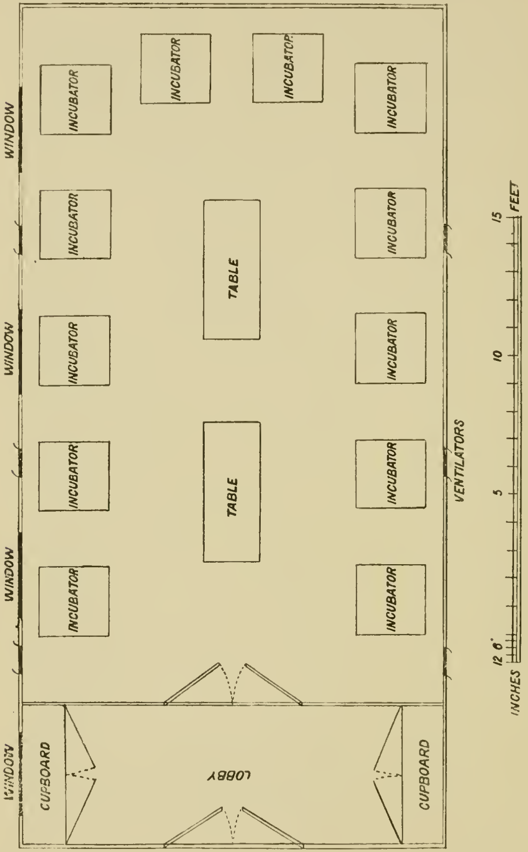


Fig. 31.—Incubator Shed: Ground-Plan.

laid upon the tables without any danger of rolling off. For the work of testing, the shutters fitted to the windows could be closed. Of course, the cost of a house such as described is considerable, but it is impossible to work successfully under antagonistic conditions, and those who go in for incubation upon a large scale will find that the capital expense is justified.

Types of Machines.—One result of the great increase in the use of incubators has been to stimulate their production, and many machines are now offered for sale. So long as the Hearson patents were in force, that type stood alone, and there was no serious competitor. With the removal of any restriction, we have many others which are confessedly copies of the "Hearson," and are sold as such, in some cases with minor modifications. Within the last few years a new class of incubator has appeared, on what is known as the hot-air principle, and it will be sufficient if we select for description one representative machine of each class. In selecting an incubator, we must look to excellence of manufacture, but primarily to the principle upon which it works. The struggle is between the tank and hot-air machines, both of which have their advocates. Our predilection has been, and is yet, in a variable climate such as that prevailing in the United Kingdom for the tank machine under ordinary conditions. We have found, however, the "Cyphers" to yield satisfactory results. This may be explained by the fact that in our incubator shed the variations of temperature were minimized greatly, and the most favourable conditions provided. The fact that incubator cellars are largely employed in America may explain why hot-air machines have there met with so great a success, though a better knowledge of essential factors in incubation, and consequent modification in the machines, has helped this result. In selecting the "Hearson" and "Cyphers" incubators as representatives of their respective types, we do so without suggesting that other appliances are not equally efficient.

Tank Incubators.—The English incubator which has attained the greatest amount of success is the "Hearson" (Fig. 32), and its widespread use in all parts of the world stamps it as an almost perfect machine. It is excellently designed and carefully made, with a marvellously delicate regulator, well applied to the purpose in view. The regulator consists of a small metal capsule, formed of two pieces of thin brass sheet, soldered together at the edges. Inside are about twenty drops of a liquid which boils at the temperature required to be maintained (104°). So long as this capsule is not subjected to sufficient heat to make the contents expand, the pieces of brass remain close together, but when the warmth is high enough they distend considerably. The power thus generated is used to work a lever, by means of which a cap is raised from the escape chimney. The hot air from the lamp, instead of entering into a tube running through the water tank, passes off, and the temperature immediately sinks again. We have known this regulator keep an incubator to within half a degree for weeks, in spite of varying weather. The eggs are laid in a concave drawer upon perforated zinc, below which is a water tray; and as fresh air can only enter from below, and has to pass through a cloth soaked with water, it becomes charged with moisture, by which means this important element is provided for. All that is required is to see that the air is not very

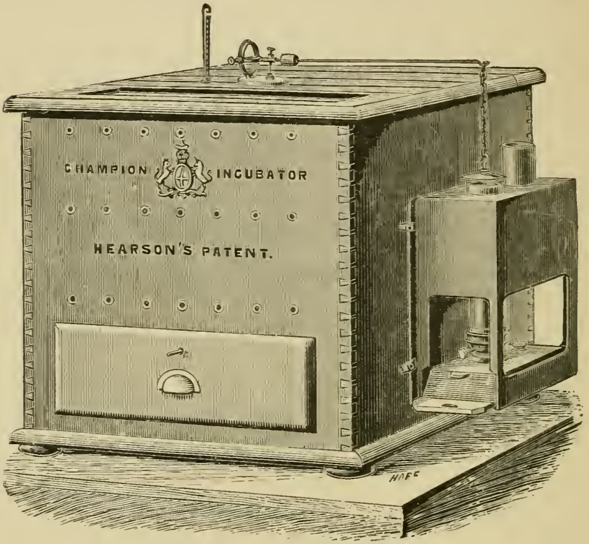


Fig. 32.—Hearson's Incubator.

cold as it enters the inlet, for then there is danger of too little water being absorbed by it. The "Hearson" incubator is made in several sizes, from a dozen eggs upwards, but we prefer the use of those of fifty to two hundred egg capacity, as these are found more reliable. Further details are given in the section drawing on p. 243 (Fig. 33).

Hot-Air Incubator.—This machine, as already explained, is of American make, and has been largely sold in Europe. Its external appearance is shown in Fig. 34. Not having a tank considerably reduces the cost of production, but it differs distinctly in other respects from the machines which are almost universal here, apart from the question of hot air. In the first place, the method of ventilation is altogether changed; there is no bottom supply of air, nor are there any holes for either inlet or escape in the egg chamber of the machine. In appearance we have the same compact body with a lamp at one side. Fresh air is drawn upwards by the side of the lamp, and is moistened

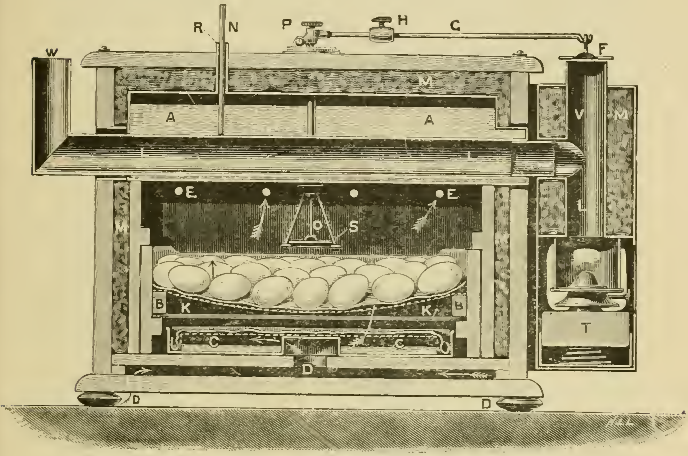


Fig. 33.—Section of Hearson's Incubator.

A A.—Tank of water.
B B.—Movable egg tray.
C C.—Water tray.
D D D.—Holes for fresh air.
E E.—Ventilating holes.
F.—Damper.
G. Lever.
H.—Lead weight.
K K.—Slips of wood.
L L L.—Lamp chimney and flue pipe.
M M M. — Non - conducting material.
N.—Tank thermometer.
O.—Needle for communicating the expansion of the capsule S to the lever G.
P.—Milled head screw.
R.—Filling tube.
S.—Thermostatic capsule.
T.—Petroleum lamp.
V.—Chimney for discharge of surplus heat.
W.—Chimney for discharge of residual products of combustion.

The overflow tube is the upper one, situated at the right-hand side of incubator, and the lower tube is for emptying the tank.

in so doing, the heated air passing into an upper chamber above the egg drawer without being affected by the fumes of the lamp. The air chamber has at the bottom a framework upon which is stretched felting, which should be replaced every two or three years, through which the heat has to find its way downwards. It will be realized that in this passage, which must be comparatively slow, there are no streams of hot air, and the heat is distributed by diffusion, which secures regularity and uniformity of temperature. The heat now passes down through the egg chamber and into a lower chamber, from which it is drawn outwards by the heat of the lamp. It is claimed in this way that there is an even distribution with regular circulation, and that therefore an even temperature is maintained. At first, in machines of this class, moisture was not supplied, as it was said that there is always enough moisture in the atmosphere to supply the needs of the chickens. That is no longer suggested, as nearly all incubators of this type have a moisture supply near the lamp. The absence of a moisture tray does away with the necessity of an influx of cold air, and therefore all the air passing into the machine is warmed. The makers state that as it enters the air increases in moisture, and by the time it reaches the air chamber its relative humidity is equal to that of the outer air. The regulator consists of a double-action thermostat. It is many years since the thermostat was first tried in this country, and given up because it was less delicate than the capsule invented and introduced by Mr. Hearson. The makers of the "Cyphers," however, have now greatly improved the thermostat, and the power is more than sufficient to maintain regularity of temperature. The fumes from the lamp escape by a chimney, over which a cap is placed similar to that met with in various English machines, and is regulated by that cap. There are several other points in this incubator which are interesting. In the first place, there is no drying box; the trays do not quite fill the egg chamber, and the chickens coming forward to the light—as there are windows inserted in front—drop down below the egg tray and remain underneath. This is an interesting change which could scarcely be adopted with safety if the inlet of air were from below, but, as the hot air descends upon the eggs, the air is not contaminated by the chickens. Trays are provided divided into different compartments, so that the eggs from different breeds may be kept in the same incubator, and distinct for registration and rearing purposes.

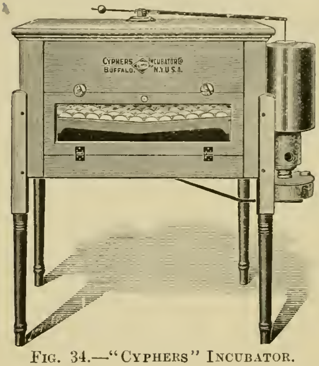


FIG. 34.—"CYPHERS" INCUBATOR.

Mammoth Incubators.—The egg ovens of Egypt are hatching-rooms rather than incubators. Within recent years many attempts have been made in this direction in Europe and America, more especially the latter, due to the enormous advance of poultry husbandry, to the establishment of large poultry farms, and to the trade in day-old chicks supplied from hatching centres, in all of which economy of labour is an important consideration. In practice, however, it has been found that the form referred to was not successful. Regulation of temperature was very difficult under such conditions, and, also, I am of opinion that the massing of great numbers and reduction of ventilation to conserve heat explain the failures. As a result, the types which have been introduced of late are heated from one source. In this way one of these "Mammoth" incubators may have a capacity for almost any number of eggs. That there will be an increasing demand for apparatus of this kind cannot be questioned. How far it will extend is a question to be determined. Their use will be restricted to the few, and, generally speaking, it will always be that the majority of farmers and others will prefer to have their own machine, in which case smaller incubators are likely to be more profitable. From the fact that changes are taking place in the types of large incubators, I do not attempt any description, as those now in use may be changed.

Management of Incubators.—The fact of having an incubator is, however, not in itself the primary question. These machines, however ornamental and well made they may be, are absolutely useless unless they effect the purpose in view—namely, the hatching of strong, liveable chickens. Hence the importance of proper management. For more than sixty years it has been possible to hatch chickens artificially. In the earlier days, undoubtedly, these birds were very inferior in natural vigour to those brought out by ordinary methods, due to many causes with which it is unnecessary at the present time to deal; in fact, it was at one time an axiom that chickens could be hatched artificially, but not reared. The explanation was that they lacked stamina and strength. The consequence was that, even where the percentage produced was a satisfactory one, the number reared was exactly the reverse. For a long time it was not easy to understand the reason for this state of things. Part, undoubtedly, depended upon the treatment of the chickens after they emerged from the shell. I believe that some of the mortality in chickens was owing to the system of removing them from the incubators very speedily after they were hatched, as well as to coddling during the period of raising. More, however, was due to a failure in realization of several points in respect to the machines themselves. Experience has shown that success with any incubator depends to a considerable extent upon evenness of temperature, but even more to the arrangement for the supply, during the entire period of development, of fresh, pure air. A badly-ventilated incubator would undoubtedly result in a large number of chickens dead in shell, varying in the extent of their development, to some degree, upon the vigour of the embryo. In seeking to conserve the heat, the danger with many machines was that the chickens whilst in the shell were not supplied with the amount of oxygen requisite for their development. Until this point was understood, there can be no question that incubators were most unreliable and doubtful as to their value. The inventor of the "Hearson" incubator must be given credit for being amongst the first to make provision for a constant supply of fresh air. At the same time, even with a machine so good as the "Hearson," much depended upon the conditions under which it was placed. Any mechanism can only operate successfully within its limitations.

An important point is the temperature at which incubators should be operated. If we were able always to keep machines in the usual spring temperature—say 60° F.—attention to this point would be needless. But we have to provide against variations, and must act in accordance therewith. Our object is to keep the eggs whilst hatching as near 102° F. as possible, as that is about the heat of a hen. In the majority of incubators it is impossible to keep the registering thermometer among the eggs, as it would either not be seen easily or would be liable to break. Hence, in nearly all makes it is above the eggs. For that reason it does not record the actual temperature, but of the stratum of air immediately above. In a machine with bottom ventilation, and in which is constantly going on a conflict between the heat from above and the cool air entering below, the difference is greater than where the air circulates downwards; but in both cases every inch makes an appreciable difference. For these reasons, the temperature at which a tank incubator is worked, as represented by the thermometer, should be varied in accordance with the following table (hot-air machines one degree less):

	Degrees F.	Degrees F.	Degrees F.	Degrees F.	Degrees F.
Room..	40	50	60	70	80
Egg chamber ..	106	105	104	103	102

PLATE X.

A Mammoth Incubator.

PLATE XI.

Interior of Incubator and Brooder House, Geflugel, Hubertus, Huls, Germany.

It will be found that running incubators on this basis will maintain eggs all through at practically the same temperature.

Moisture.—That a certain amount of moisture is required in the air surrounding the eggs during the incubatory period is an undoubted fact; but even at this date, after upwards of thirty-five years in the practice of artificial hatching, it is impossible to state with any degree of certainty what weight of water vapour per cubic foot of air is necessary. In practically all incubators, whether of the tank or hot-air type, some means are provided of adding moisture to the air in the egg chamber. In machines of the former type this addition is brought about by use of a water tray under the egg drawer; in the latter type a damper which delivers its moisture to the ingoing air is employed. As it is impossible to give any definite figures in this connection, we advise all operators to adhere strictly to the instructions given by the maker of the incubator they are working.

The whole question of the influence of moisture in incubation requires solution, but, although experimenters are working along this line, no definite results have accrued. It is our opinion that, for the successful hatching of a large number of liveable chickens, all eggs should lose a definite proportion of their original weight during the first nineteen days of incubation, but at the present there is no simple way of determining the exact rate or extent of the loss. Until such time as more exact information is to hand, the advice given above should be followed.

General Hints.—The following general hints should be observed by all incubator workers, in addition to directions sent out by makers of each machine:

1. Place the machine where there will be a constant supply of fresh air, but carefully avoid draughts.

2. If possible, keep the temperature of the room at from 55° to 65° F.

3. See that the water trays are regularly supplied with water, which should be first warmed.

4. Always warm eggs before putting into the machine by washing in water heated to 80° F. This is specially important when there are eggs already in the drawer.

5. Mark the eggs with the date when put in, and that when due. Also, if there is no turning apparatus, put signs " X " and " O " on two sides to know how far they should be turned. This should be done twice a day, but must be once.

6. Cool the eggs twice a day, for ten minutes in winter, and for fifteen minutes in summer; but if the room is warm longer

cooling is recommended. In tank machines the lamp flame should be lowered or removed whilst the eggs are being turned and cooled.

7. Observe the temperature of egg drawer whenever the incubator is attended to, as a guide to its correct working.

8. Do not open the egg drawer too often whilst hatching is proceeding; when the chicks are out, remove the empty shells, and place the chicks in drying box, where one is provided.

9. Always keep the lamp clean, properly supplied with oil, and do not burn it higher than is necessary.

10. See that there are no vibrations or jarring shocks in the incubator-room, as these cause deformity in the chickens.

CHAPTER XVI

REARING, NATURAL AND ARTIFICIAL

Provision for rearing chickens varies to a much greater extent than does hatching. In this direction there can be no absolute uniformity. Much depends upon the conditions available and the opportunities presenting themselves. A further point is that, whilst the natural and artificial methods of rearing must necessarily differ, practically speaking the period during which such differences exist only extends over the first six to eight weeks of life, after which these disappear. When the birds are intended for early killing, the system of growing adopted is a non-natural one, in whatever manner the chicks are hatched and reared. That aspect of the case is dealt with in succeeding chapters. Therefore, whilst there must be differentiation as to the early stages of rearing, such disappears at a later period.

Place to Rear.—Chickens require dry conditions, more especially in the coop or house where they spend the nights, and also on the surrounding ground. Damp is fatal to them, more so than any influence against which they have to contend. The ideal spot is on the southern slope of a hill on which are an abundance of bushes or trees. If, however, such could alone be used, that would limit the work to a comparatively few people. All others must make the best possible use of their conditions, as these cannot be altered. At the same time there is generally a measure of choice. The prime factors are—first, a dry, kindly soil, well drained, so as to rapidly carry off the water in wet weather; second, for early broods, a position which at one and the same time enables them to take advantage of all the sunshine there may be, and yet protects them against strong, cold winds and driving rain; and, third, that the soil shall be good, containing as much of natural food as possible, more especially after the infantile stage has passed. Sand is deficient in this respect, and should be avoided. Insect and grub life, and green food, are necessary to healthy and rapid growth, and exercise in seeking for the former conduces to development. Clay soil, by reason of its cold nature, retards growth. Whilst that is not serious where birds are intended to be matured as layers, for table birds it would cause an increase of cost in feeding, and the birds would never be as good in flesh qualities. One point must be emphasized—that during hot weather exposure to intense sunlight is detrimental, and at the period named as much shade should be given as possible. What we have to do is to guard against extremes of heat or cold, and to conform as far as possible to the natural rearing season.

Fig. 35.—Chicken-Rearing in Orchard.

Chicken Houses or Sheds.—During the ordinary period of the year, whether the birds are reared in coops or brooders, the plan to be universally adopted is to place these out in the open. When, however, it is necessary to undertake this work in the winter season or very early in the year, a house or shed in which the coop or brooder can be placed is valuable in the extreme, as it affords the shelter which is essential, more especially as the chicks then bred are usually of the more susceptible races, less able to withstand adverse conditions. Under these conditions, if they are to be reared artificially, and the number warrants the cost, the plan commended is to build a brooder house as described later. One of the best arrangements I have ever seen consisted of a large, lofty, open-fronted, thatched shed, about 60 feet in length and 20 feet deep, wherein the coops were placed, and the chicks given freedom to range within its limits. They were practically in the open air all the time, and, as the floor was thickly covered with fresh earth from time to time, they found abundance of exercise. The practice was to use this only in bad or very cold weather, and to move the coops outside whenever fine. It would hardly pay to erect such a structure, and on few places is one available. When, however, that is the case, even if used for other purposes during the greater part of the year, it will help materially in the work of winter rearing. This is not a question of coddling—for that is an economic blunder—but merely of equalization of the conditions. If the operations warrant erection of such a structure, it need not be out of use when vacated by the chickens, as it may be found useful for other purposes, such as a fatting shed, or even as a house for layers, or for growing chicks which cannot be out in the open.

Coops and Cooping.—If only a few batches of chickens are to be raised upon a farm, suitable provision can easily be made for them. Each hen and her brood can be provided with quarters in sheds or outbuildings, and be given freedom during the day. With extension of the work, however, it is necessary to coop the hens, not alone for shelter and protection, but to prevent injury to chickens, as hens are usually very pugnacious.

Many different forms of coops are in use, some of which are too elaborate and needlessly expensive. The simpler these are, the better. When coops are out on open fields, it is necessary that they shall afford protection against enemies—not merely the predatory fox, but the insatiable rat—otherwise anything more than a simple box with open front is not required. Even under the circumstances named, whatever leads to insufficiency of ventilation is harmful in the extreme, and it is in that direction where so many coops are unsatisfactory. As to size, I am confident that it would be preferable if coops were somewhat larger than at present—say about 2 feet square—as that would allow a greater amount of room and of air-space for the inmates.

Where the front is barred—and that should always be the case—ventilation is provided for. Upon drier soils a wooden floor is undesirable, and the inmates are much more comfortable even without hay or straw. If rats are troublesome, fine meshed-wire netting may be stretched across the bottom, in which case a handful of soft covering material is necessary. On very cold or damp ground a wooden floor may be used, but nailed upon cross-pieces, so that the floor boards do not rest upon the earth. This should be loose from and fit inside the coop, thus facilitating cleaning. It may be dispensed with altogether when the conditions are more favourable. Coops should be well limewashed out and kept rigidly clean.

Forms of Coops.—It is unnecessary to describe at length the different forms of coop in general use, some of which are represented in the illustrations. As already stated, these appliances

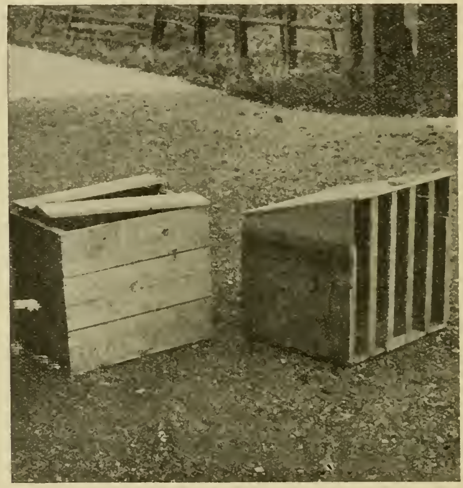


Fig. 36.—Coop made from Sugar Box.

may be made very cheaply. In the *Illustrated Poultry Record* was described one which is within the limits of all, consisting of a Tate sugar box. This, with a few nails and an hour's work, will form a handy, serviceable coop, that may be used as a sitting box also, at a cost of 4½d. To make, the lid must be taken off the box, and the nails removed, when they can be straightened and used again. One side will form a floor, if required, and the other should be carefully taken off. Two of the lid strips must be cut as a long triangle, 3 inches at the front to 1 inch at the back, and fastened above the open sides, with four narrow pieces inside to hold them firm. The laths, taken from the open side, must now be nailed above the sloping pieces, and with a strip from the lid will make a top having the requisite slope to carry off the rain. There will be just enough remaining of the lid to cut into bars for the front, two of which should be made loose to let the hen in and out.

One of the earliest forms is the Sussex coop (Fig. 37), which is still largely used. It is triangular in shape, and presents at front the appearance of an A. This generally stands about 24 or 27 inches high in the centre, and is the same width at the ground. The sides and back are solid, but the front is made of upright laths, one of which is loose, so that when raised the hen can get out. Of course, the laths, as in all coops, are sufficiently apart to allow the chicks to pass between them. It usually has no floor, but in such dry districts as Surrey and Sussex a floor is not needed in any coop. This type may be regarded as old-fashioned, but it is none the worse on that account.

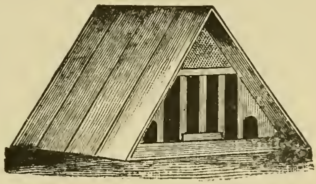


Fig. 37.—Sussex Coop.

Another is shown in Fig. 38, which is built square, and may either be gabled or have a top sloping from front to back. Instead, however, of the shutter, which is undesirable, a preferable arrangement is to have fine wire netting upon a frame closely fitting the front, as marauders can thus be kept out. When a wire run is used, that will effect the same object. In fact, a run should generally be used for the first few days, except when the hen is allowed out; otherwise the chicks are liable to stray and not be able to find the way back.

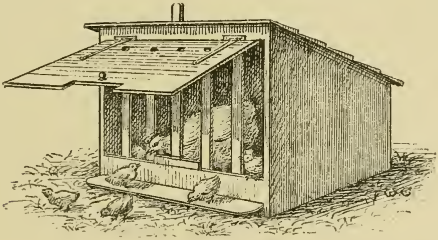


Fig. 38.—Square Coop.

Fresh Ground.—A most important point in the management of naturally reared chickens is that the coops shall be moved on to fresh soil daily. Nothing will more speedily taint a piece of ground than a brood of chicks, and to maintain them in health it is desirable that they be given sweet, fresh earth to run over. Fortunately, during the growing months earth quickly sweetens again. Where a large number of coops are employed, these should be arranged in rows widely apart, so that in moving the same space shall not be occupied for at least a week or ten days. Where chickens are reared on a very restricted area, and it is impossible to move the coops sufficiently, fresh soil should be brought and placed under and within these. Grass sods may also be used in the same manner. Such removal and absolute cleanliness are the chief factors making for success in rearing.

Brooders.—When first introduced, brooders were of the individual type; that is, whilst accommodating a larger number in one batch than could be cared for by a single hen, the flock was a unit, and handled as such. Practically speaking, each lot formed a colony or household, separately controlled, in which artificial warmth was substituted for the natural. The brooder was moved on to fresh ground in the same manner as are coops. That system was in conformity with smaller operations, and it may freely be acknowledged that, provided the apparatus is good and the management efficient, in actual results it is still the most satisfactory. With, however, breeding on a much larger scale, and especially as artificial methods of hatching enable greater numbers of chickens to be brought out at one and the same time, the question of labour became a very serious one. To breed a thousand chickens would thus mean a score of separate brooders, not alone involving a heavy capital expenditure, but the regulation of twenty lamps, the feeding of twenty groups of chickens, and the cleaning of twenty of these apparatus, the combination of which appears to be an unnecessary expenditure of effort and of time. Only those who have undertaken such a task can realize what is involved, and in unfavourable weather the risks are considerable.

As a consequence, with the growth of poultry husbandry in respect to extent of operations, the desire to concentrate the chickens in greater numbers and to adopt a central method of heating became generally manifest. In this direction much has been learnt and unlearnt. Many of the methods adopted failed. They ignored the fact that chickens are living entities, and are not amenable to what may be termed a factory system. It is unnecessary, however, to describe such methods, as they have passed into oblivion. Costly though the experience has been, the value is considerable, for we know more fully what to avoid. It may be freely and frankly acknowledged that an increase in the number of chicks massed together enhances considerably the risks involved, as these birds are more liable to diseases of various forms, whilst the mortality is usually much larger. That is not peculiar to poultry, but is experienced in every branch of animal life.

Systems of Brooding.—At the present time the methods adopted resolve themselves into three classes—namely, first, individual brooders, each distinct and operated separately; second, colony houses, fitted with a portable brooder which can be removed when heat is no longer required; and, third, range brooder houses. As shown below, the last-named vary considerably, especially in the method of heating. Up to the present time, even for the rearing of table chickens to be killed at an early age, the third method has been least successful, and in some cases the mortality disastrous in the extreme. Here, again, the choice lies between distributive and ultra-intensive methods, and the latter has come off second-best to a considerable degree. In Chapter XVII. a system is described of rearing chickens on shelves or in flats, and under Individual Brooders reference is made to the heatless method of rearing.

Individual Brooders.—The first brooder I used was in 1877, a very primitive affair which need not be described. Keeping the lamp burning at the right power was no joke, especially in bad weather, of which there appeared to be an abundance that season. In spite of many difficulties the final results were remarkably successful. Out of about eighty chickens all save two were reared. The apparatus was placed under a rough shed, and the birds could not leave the brooder without full exposure to air and wind and rain. Encouraged by this success, the following year I built a shed in which to place the rearer, giving the birds plenty of space under cover, but so arranged that they could go only outside when I thought fit. What appeared to be more favourable conditions proved less successful. The *pro rata* mortality was greatly increased. That lesson has never been forgotten. It may be equally applied to present conditions, probably explaining much loss that arises, although there doubtless were other contributory causes, such as increase of numbers beyond the capacity of the machine.

For the small poultry-keeper who buys a batch of day-old chicks, and has not a hen available to take charge of them, a simple and inexpensive brooder may be used, of which several similar forms are sold. It must, however, be under a cover or be placed in a coop, as it is not made for outdoor work. Brooders of this type can be made out of tubs, and a paraffin barrel cut in

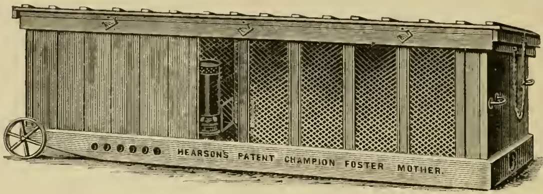


Fig. 39.—Hearson's Foster-Mother.

two would make a couple when fitted with loose floors, lamp, casement, and chimneys. Plenty of ventilation holes are a necessity. One great advantage is that the flocks are small.

A type which is largely employed for outdoor work is shown in

Fig. 40.—Miller Brooder.

Fig. 39. Of this there are many representatives, as nearly every appliance maker lists one built on this principle. These brooders practically combine house and brooder in one, and are fitted with handles for lifting or with wheels, so that they can be easily removed. Some have hinged tops or covers, whilst others

have a sliding lid, the latter of which is a distinct improvement. Usually they are in two compartments: first, the brooder proper, and, second, the covered run. In the "Hearson" the former is fitted with a small radiating tank or boiler, heated by a lamp placed in the covered run, so that no fumes can enter the sleeping compartment; in others the lamp is placed therein, surrounded by a wire guard to keep the birds from it. There have been introduced apparatus with three compartments: (1) The brooder, (2) the inner compartment with wooden floor, and (3) covered run without floor. In practice, however, these triple-compartment brooders have not proved of any advantage. Where what is known as the dry method of feeding is adopted, the preferable plan is to have only two sections and add a floor to the run.

Another type of outdoor brooder is shown in Fig. 41, which differs essentially from English forms, and has been designed to meet scratching requirements on the part of chickens. It has two compartments. That at the back, as seen in the illustration, is the brooder proper. In this is a "hover"—namely, a circular board, with flannel fastened to the edges, radiating the heat, obtained from a lamp placed below, upon the chicks. The inmates are not restricted, and can pass in and out as they think fit. Frequently, when older, they prefer to sleep outside the "hover." A slope leads down to the non-heated compartment, in which grain and seeds are fed in litter. A netted run is often fixed in front, access to which is obtained by means of a small door. Save that the lamp is somewhat awkwardly placed, I have found this form of brooder excellent in the results obtained.

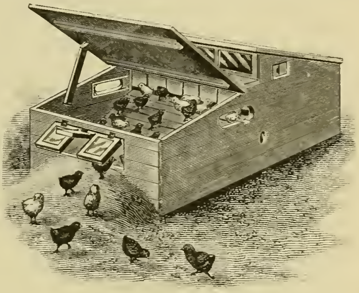


FIG. 41.—OUTDOOR CYPHERS BROODER.

Within recent years fireless brooders—that is, without artificial heat—have been introduced, and with some measure of success, though not as great as expected. In these, by conservation of natural body heat of the chicks, it has been found that during the greater part of the year chickens can be reared successfully; and whilst they may not grow as rapidly as in heated brooders, they are more vigorous and feather much better. This leads to consideration of the question whether a hen gives warmth to the brood or simply prevents elimination by covering and sheltering them. In our climate, however, practical experience has shown that in winter and wet weather the insides of these fireless brooders become damp, and chills result, which, however, may be due to condensation of moisture as a result of insufficient ventilation. The problem here indicated has yet to be solved. It would be a great gain if heat could be dispensed with, both as to cost of apparatus and labour. We have not, however, arrived as yet at that stage. I cannot, therefore, do more than mention this class of brooder.

Where many machines fail is that they are dark and insufficiently ventilated. Conservation of heat and reduction of cost in

Fig. 42.—Fireless Brooder.

operation are dearly purchased if we deny to the birds the elements and conditions essential to growth and development.

Colony Brooders.—The first colony brooder that I saw was in France, many years ago. An ordinary portable house was fitted with a brooder which could be removed when the chickens no longer required heat. In large measure this arrangement was due to the fact that French breeders regard it as desirable for chickens to remain in the environment with which they are familiar. What they suggest is, move the house and the chickens together to fresh ground, but not the chickens from the house. For that something is to be said, although it would profoundly modify our present methods, by which we appear to assume that fowls have no feelings whatever.

At Cornell University, in the State of New York, Professor J. E. Rice has introduced successfully houses of a similar class, in which were placed brooders heated by gasolene, capable of removal as the birds arrived at an age when heat no was longer required. These were placed in runs where the birds remained all the time. There is no reason, however, why such a system should not form an integral part of an extensive method of rearing, in connection

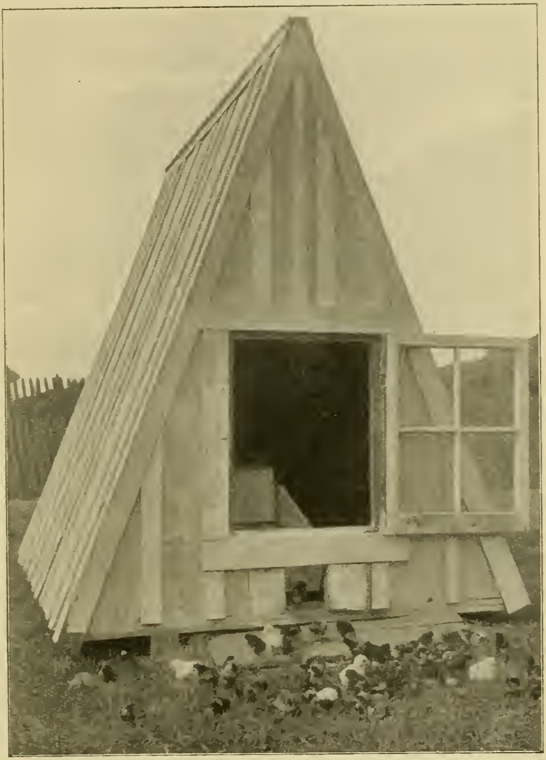


FIG. 43.—CANADIAN BROODER HOUSE.

with which the advantages of distribution and free range would be secured. In fact, my own view is that future developments will be more on these lines than has been the case heretofore. The doing so would minimize cost of equipment; and although labour of attention to the brooders would be greater than under concentrated conditions, the lessened requirements of the birds after the first few days would more than compensate; and dangers arising from massing larger numbers together, and of earth contamination, would be avoided—that is, where the land available is sufficient for the purpose. For this work single individual brooders—*i.e.*, without runs—could be used. In Fig. 43 is represented an apex Canadian brooder house, in which the brooder is placed, though the form of the main building, so long as suitable, is not of great importance. Nothing could be better for this purpose than an ordinary open-fronted poultry house.

Brooder Houses.—It has already been indicated that, as operations in respect to poultry husbandry have increased in extent, the tendency is to mass the birds in greater numbers. That is seen in the case of adult laying stock, as previously referred to. It is equally so with chickens and ducklings. Probably within recent times the one has led to the other. It is an attempt to apply the factory system. Some of the plans laid down have been complete in the extreme. Several years ago particulars were published of a horseshoe house for chickens, embracing, if I remember rightly, twenty-five to thirty compartments. The plan was to hatch, say, a couple of hundred birds every third day, moving onwards regularly from one section to another, so that when the last was reached these would be of an age and in fit condition for killing. Many other trials have been made on a less pretentious scale. The only trouble was that these schemes do not work out in practice. Perfect on paper, they were imperfect in execution. In these and a multitude of other cases the mistake made is in attempting too much, and in disregarding natural factors which are powerful in the extreme.

I do not suggest that a brooder house may not be of the greatest service, and, in fact, should always recommend one of a moderate size, more especially for early batches of chickens or ducklings, or even such birds as are intended for killing. In these directions the advantages are obvious. That, however, is a different proposition to use of long-range brooder houses entirely. I am inclined to the view that the short history of some of the more pretentious poultry plants was due, in part, to false systems of rearing, leading to degeneracy of the stock, combined with soil taint in the runs, which could not be avoided as a result of immovability. In fact, the last-named point indicates an insuperable barrier to success in these big brooder houses, where, to meet capital and other charges, the numbers maintained must annually be very large. I have seen structures of this class 250 feet long, skilfully designed, and the system carefully carried out, but they did not pay. That is the final test.

Nor is the question determined by methods of heating. After trials have been made by circulating water and hot-air pipes of various kinds, it would appear that those who have tested these methods most fully have reluctantly been compelled to revert to individual brooders, even when these are placed in long brooder houses, so that each flock may be treated as a unit and not as part of a great mass. That being the case, the virtue of large houses has disappeared. My own suggestion is that, where this system is preferred, the plan to follow is to have ten 30-feet houses rather than one of 300 feet. If wisely distributed the risks of earth or soil taint can at least be minimized, which is an important factor. This may appear a compromise, but all successful businesses are that, and poultry husbandry is not exempt from the same influence.

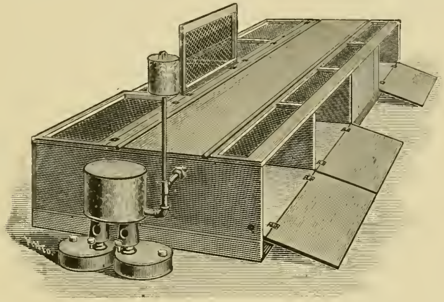


Fig. 44.—Cyphers Four-Section Brooder.

For houses what are known as sectional brooders (Fig. 44) may be employed, as in these only one heater is required. These are made in varying lengths, and, as they are separately fitted, they can be used in any suitable building. Each section as shown is 3 feet long, 18 inches wide, and 11 inches high. They are fitted with pipes heated by a lamp at one end. Except for experimental work, in which equality of conditions is important, I regard the individual brooders as preferable.

Methods of Heating.—In the long-range brooder houses to which references have been made, where water or hot-air pipes are used, a furnace is employed, thus simplifying the work. Under such conditions fire risks are reduced, but flexibility is wanting. On the establishment of Herr P. Sweers at Huls, near

Crefeld, Germany, the heat is supplied by means of a boiler placed in a well at one end of the brooder house. Pipes pass under the floors of the brooders, which are insulated, so that they are cool. Air enters from below, and, passing over the pipes, is warmed, ascending through a metal cone, working in a thread screw, by means of which the supply of heated air can be more or less regulated. Above is a revolving hover working on the same screw, and the height can be graduated in accordance with the size and age of the inmates. For individual brooder lamps, whether used outside or indoors, petroleum is generally used. And in colony brooders gasolene is often preferred, for which a special burner must be employed, as it is very inflammable.

General Hints.—The main points to be observed in the artificial rearing of chickens are—

First, that there shall be no overcrowding. Also every bird must have sufficient space. Greater success is achieved with smaller flocks, say thirty to fifty, than with very large ones.

Second, that fumes from the lamp must not enter the brooding compartment. It is here where many cheaper machines fail.

Third, that whilst for the first few days warmth must be well maintained, say 90 degrees or even a little higher, it should be gradually reduced until at four to five weeks it need not exceed 65 to 70 degrees. In mild weather the temperature should be further reduced during the day.

Fourth, regular attention to lamps and flues is essential, and absolute cleanliness is of supreme importance.

Fifth, for chickens in outside brooders as much sunshine as possible in winter and as little in summer is desirable. We need to strike the happy mean in temperature.

The Early Days.—For the first twenty-four to thirty-six hours after a chicken is hatched it needs no other food than is provided by Nature. The yolk bag, which is absorbed into the abdomen prior to the breaking of the shell, contains all the food needed for the time already stated, or even longer. Harm is often done by forcing young chickens to eat, and it is not improbable that derangements of the stomach are set up in this way, especially as rich food is often given. When the proper time comes, there will be no need to force eating. The cravings of Nature will remove all necessity for that. But the hen ought to be fed well, and when the anxiety of her maternal trial is over she will be ready for and need something calculated to brace her up again. The late M. Van der Snickt, of Brussels, declared the chickens at liberty can go four days before any food is supplied, and will be much more vigorous than if fed earlier. I have proved that statement up to seventy-two hours.

Feeding Chickens.—The whole question of feeding young chickens deserves the fullest attention, as upon it will largely depend the future of the birds. As already stated, there has been a revolt against pampering, but it is necessary to avoid going to the other extreme; one would be just as unsatisfactory as the other. The plan which I adopted for many years has been to feed, after the first twenty-four hours, for three or four days upon hard-boiled eggs and breadcrumbs, slightly moistened with milk; but I am bound to confess chickens are reared without the egg quite as successfully as with it. After the third day of egg-feeding it was customary to give alternately for the next fortnight Spratt's chicken meal, oatmeal, ground oats, and boiled rice, all properly prepared by steeping or cooking. From the period named the boiled rice was given very seldom, and broken wheat or buck-wheat, or in some cases crushed oats, were added to the diet. My experience has been that this system, properly caried out, yielded in the great majority of places the maximum of results when rearing took place under hens; but it was not found nearly so satisfactory when brooders were employed.

A few years ago all appearances were that artificial rearing on a large scale was an absolute failure, due to the heavy mortality. That was equally true in Europe and America. In our own case deaths reached in one year 40 per cent., and in others the average was much greater. After observations and experiments extending over three seasons, when everything possible was done in the way of prevention, I came to the conclusion that it was due to weakening of the system by denial of the opportunity for exercise. The system described below tells how this was overcome.

It is natural for the organs of the body to be used as much as possible, and experience has shown that hens which have to work in this way for their living lay better and are healthier than if they are fed without giving them anything to do, as is often the case with birds in confinement. The latter system may be desirable when the birds are to be killed off, but not when they are to be kept as laying machines. It was this fact which led to the adoption of the scratching system in connection with the rearing of chickens. The chief trouble which we had in rearing was seen in an inflammation of the bowels, leading to diarrhœa or dysentery, and in some cases the lungs also were affected. I need not describe the affection further, because most of those who have attempted to rear chickens in the winter season have had similar experience. It would appear that this trouble was due either to dampness or to want of exercise, because the same food was employed as at other periods of the year and under other conditions when it was most successful. The lack of exercise, however, seemed to make the birds more subject to chill, and thus the dampness would affect them to a greater extent. The plan adopted was as follows: The large brooder house had the floor littered to a depth of several inches with cut chaff; in the open-air brooders were fitted floors to the covered runs in makes that were suitable. So far as feeding was concerned, the main idea was that the birds should have to work for their living, and the food be to a large extent seeds and small grain. All the time grit in abundance was thrown amongst the chaff, and it is surprising the quantity of that material the birds will consume. Of course grit is an absolute essential, otherwise the chickens would be unable to digest the seeds and grain. In addition there was supplied plenty of water, which should be given fresh two or three times a day, and an abundance of green food—lettuces or young cabbages. In fact, success hinged largely upon the green food supplied. The birds consume a very much larger quantity of water than would be the case if they had principally soft food.

The point to consider is that the chickens, after their morning feed, cannot possibly secure any of the seeds without working for them. These all fall to the bottom of the chaff, and the chickens scratch to find the seeds; in finding one they cover up the rest, and so on all day. It is no question of being fed so many times a day, because they are always eating and always working. The percentage of loss after the system was introduced was infinitesimal. The system here recommended is not in any sense cheaper than the old method, and unless care is taken it may be considerably dearer; but it is rather a question of growing a fair percentage to a killing age. Judgment has to be exercised in supplying sufficient food without giving too much. The chaff needs to be renewed about every ten or fourteen days, oftener if the number of chickens is considerable. When taken away, it is a very excellent plan to throw the chaff into the scratching sheds for adult fowls, and they will generally find something that is worth working for. Dry feeding alone is not desirable. The best results have followed when a proportion of soft food, as shown below, is given after the second week, otherwise the chicks make slower progress.

The following is the dietary which has proved most successful under this system:

First fortnight: Millet, dari, buckwheat, canary-seed, in equal parts, and granulated meat.

Second fortnight: Spratt's meal, cooked rice or oatmeal, dried off with ground oats, adding a little bone-meal and 15 per cent. of meat as morning feed; grains as above, with broken wheat added at other periods of the day. Gradually reduce the canary-seed.

When a month old: Abolish small seeds and add cracked maize.

When six weeks old: Barley-meal, toppings and meat, mixed and given warm in the morning; whole wheat, barley, oats, and cracked maize; green food all the time.

A word of warning is necessary where it is intended to fatten

Fig. 45.—An Excellent Type of "Halfway" House.

the chickens. Under these circumstances they should be fed to a greater extent upon soft food after they are a month old, otherwise the crop will not be expanded enough to enable them to bear the cramming during the final stages—that is, to hold sufficient food for the best results.

The Orphans.—As a rule young birds when about six to eight weeks old, whether raised naturally or artificially, are left to their own resources. Provision must thus be made for the orphans. What this provision will be depends upon the season of the year, and, to a certain extent, the nature of the chickens. If the weather is warm, and they are of a hardy race, they may be put at once into a portable house similar to that shown in Fig. 45. In this case it will be desirable to provide special perches, but bent breast-cones would result if they were allowed to roost on ordinary narrow perches. These special perches should not be less than 6 inches broad, and have the edges carefully rounded off. At one time we used broad shelves, but the 6-inch perches are in every way as good. Some breeders do not permit their chickens to roost on perches until they are well grown, but make a thick bed of sand or straw on the floor. In unfavourable weather it is often desirable, especially with chickens that are artificially reared, to transfer them to what is known as a cold brooder. If to be used under cover, it is enough to build a roomy frame upon which canvas is tightly stretched, forming a cage or inner compartment, or to use a large well-ventilated box. The object is simply to afford protection against cold at night.

Division of the Sexes.—A wise plan is to separate the sexes in chickens as soon as these can be distinguished. Breeds differ in attainment of maturity, so that no fixed time can be stated. Usually the combs of the young cockerels are the first indications of sexual development, and as soon as these are evident the time has arrived when separation should take place. In the lighter and quicker-growing breeds that will be from six to eight weeks after hatching, and in the heavier races two to three weeks later.

Hardening the Chickens.—Except for such birds as are to be killed at an early age, with which there should be constant and even rapid growth, it is necessary to build up a strong constitution, to secure which object a measure of hardening is desirable. Wherever possible, the wiser course is to put the birds out on range, where their foraging instinct can have full play, in the which they will obtain the exercise which leads to bone and muscle development. That can usually be done with safety at from ten to twelve weeks, according to the breed. During this period the food should be entirely grain, which may be placed in hoppers to insure a sufficient supply. Where the environment compels restriction they should be in large runs, in which is a roomy scratching shed, and the food supplied in litter.

CHAPTER XVII

PRODUCTION OF TABLE POULTRY

UNDER ordinary conditions specialization either for the production of eggs or flesh was practically non-existent. The former were eaten or sold when forthcoming, and the surplus chickens or older birds were killed when ready. Such could only continue so long as the state of affairs was primitive, and the volume of supply as great or greater than the demand. For several centuries in some countries and areas a measure of specialization has been adopted. Nature herself works in that direction, evolving, as a result of climate and soil, races which are better for one quality than another, in which case the development of either fecundity or meat properties respectively is at the expense of the other In this way, plus selective influences, we find breeds in some districts are known for a special quality. Thus the south-eastern counties of England and the south-eastern districts of Ireland have become famous for their chickens, the south Mildands of England for ducks, and East Anglia for turkeys. The same is true on the Continent of Europe, where in France several districts, notably the Bresse country and parts of Normandy, have produced the highest grade of chickens, and in Belgium and South Germany areas are found in which meat properties have received special attention. The primary point, therefore, is that conditions shall be favourable. Eggs may be produced almost anywhere, but not table poultry. In what may be termed the egg districts surplus birds will always be found, and the greater the production the larger the number of these. Information is given in Chapter VI. as to the influence of soil, which is of very great importance in meat production. Suitability in that direction, and also a plentiful supply of milk for the fattening process, are the essential factors.

The Fattening Industry.—In the following paragraphs is given information as to the methods adopted, mainly based on English practice, to which is added experience in other lands. That there has been great growth in this branch of poultry husbandry is evident, and the future will undoubtedly see developments on a wider scale. Even in America and Russia and Hungary, where at one time the system was unknown, has it been realized that the fattening process is economic, and that to kill a bird in lean condition is wasteful in the extreme. We are simply applying to poultry the principles which are adopted in connection with larger stock—namely, that an animal or bird should be fed off prior to killing, and that by such method the edible portions of the body can be greatly increased. With respect to chickens and fowls, in three weeks from 1 to 3 pounds can be added to the weight, mainly of the flesh, in accordance with the size and capacity for development, at a cost of about eightpence. Improvement in softness and quality of the meat and of general appearance are also considerable. As examples, when this system was adopted in America and Russia, the position and value of birds from those countries was enormously enhanced on English and other markets.

In France many farmers' wives are skilful fatters, and thus finish off the birds reared by themselves. Some of the finest specimens I have ever seen were the result of such methods. Elsewhere the work of rearing and of fattening is generally dissociated. Such is true in all countries with which I am familiar. Collectors scour the district around for birds to fill the cages, buying from farmers and cottagers who rear them. Carts loaded with pens of fowls form a common sight in Sussex and West Kent, to be met with on every road and lane. Sometimes a man may be met with a cage upon his back, used for byroads, and he meets the cart at a determined point. These back-cages are made curved, and hold a couple of dozen birds, built in two tiers. When filled they are no light load. The higglers know just where to go, and when a supply of chickens will be ready for them. In Belgium the plan is for the rearers to bring their lean birds to fixed markets, where they are met by fatteners who purchase in that way.

Many attempts have been made to combine the work of breeding, raising, and fattening. Except when operations are on a comparatively smaller scale, as in France, these have failed. It would be a great gain if this finishing process were more widely known, especially in the neighbourhood of residential centres, where a direct trade can be secured. In those districts not in this favoured position, the produce of which must pass through trade channels, the marketing problem is supremely important, and the dual system has great advantages. Those who raise the birds obtain much better prices than would be possible if each had to find buyers, and the fatteners are able to organize a better, larger, and more regular supply. Moreover, the work of fattening is highly specialized, requiring considerable skill and experience.

A Method of Ripening.—Fattening is a method of ripening. Fat or oil laid upon the various tissues throughout the body softens, and has the effect of making them more tender. This is the same process found working in all Nature. Fruits fill out, and are plumpest and sweetest when they are ripe. In both cases the ripening, if continued too long, tends to decay. It is just as reasonable to say that grapes are not good to eat at their prime, because if allowed to hang longer they go bad, as it is to say that the fact a fowl goes back if fattened too long is a proof that fattening is a wrong system. Breeders and layers should be kept in lean, hard condition. At the same time we can realize the value of fattening for fowls destined to immediate slaughter. This immediate slaughter is absolutely necessary when birds have been fed up in the way named, for the fat upon their tissues prevents the organs performing their functions properly, so that diseases of various kinds are soon generated. The great Liebig was accustomed to say that all fat is a disease. That had reference to human beings, who are not intended for slaughter, and his dictum must not be regarded as applicable to the preparation of table fowls.

Fattening.—In fattening poultry, or, in fact, any other animals, two things are absolutely necessary. First, that the food supplied shall tend to the production of flesh; and, second, that the conditions under which fowls are kept shall eliminate as little of the oil or heat fuel as possible. It may be well here to explain that, although the term "fattening" is employed, merely laying on an excessive quantity of fat or oil is not meant, such as was at one time the case with cattle and sheep; the addition of the fat is necessary, in that, as already explained, it softens and ripens the flesh. The reason why the flesh of a ripened fowl is finer in flavour and more digestible is that fat takes the place of water in the tissues. This, when cooked, melts and softens the flesh, whereas water evaporates and leaves it dry and harder. Professor Warington, F.R.S., calls attention to the fact that the rates of consumption and of increase vary considerably in different parts of the period. As a fattening animal increases in size the quantity of food it consumes also somewhat increases; the stomach at the same times becomes larger. When the animal becomes very fat, the consumption of food falls off again, and the rate of increase at this point is much diminished. As fattening advances, the daily increase in live weight becomes gradually

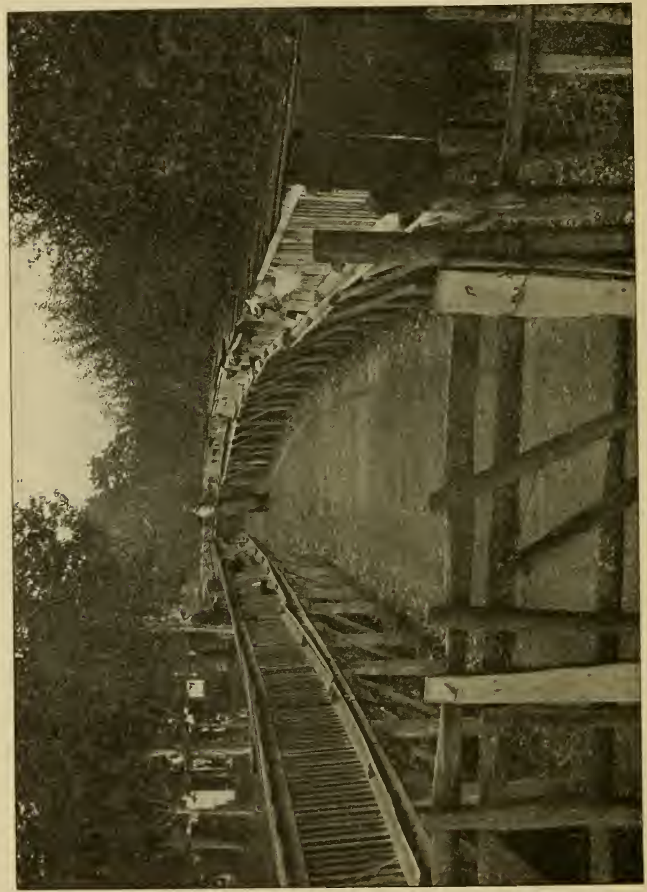


Fig. 46.—Outside Fattening Cages.

smaller, and the same amount of food will produce a steadily diminishing amount of increase.

* "Chemistry of the Farm." London: Vinton and Co., Ltd.

Cages.—There are many different methods adopted by fatters, but one general idea appears to prevail. During the milder months of the year many fowls are partly, and sometimes wholly, fatted in outside cages, placed under the lee of some hedgerow, or where they can be protected from wind and rain. In the Uckfield district of Sussex, and in Kent, a large amount of fruit is grown, and these orchards are utilized for the accommodation of outside fattening cages. Fig. 46 shows an example. These outside pens or cages, as, in fact, those inside also, are very simply made, consisting of laths of wood, generally about 1 inch wide and 1½ inches apart, except the bottoms, which have the laths narrowed below, so as not to catch the droppings. Each cage should be 7 feet 6 inches long, 20 inches from back to front, and the same in height, divided by laths into compartments of 30 inches, holding three or four birds. To each compartment is fitted in front a sliding door. The cages, which are usually in single tiers, are raised about 3 feet above the ground, upon what are called stages—cross-pieces of scantling supported by posts fixed in the ground.

In not a few instances everything is of the simplest and cheapest description, and the opportunity is taken of a slack season to put together what further cages are likely to be required either for renewal or extension of operations. They are also made and supplied at reasonable prices. Shelter against wind and rain is most important. A thick hedge is very serviceable against wind, but the tops of the cages should be covered in with a sloping wooden or corrugated iron cover, or branches of trees, which are regarded as best of all, by reason of the fact that they are coolest, allowing for the circulation of air. In front is fitted a long wooden trough, made V-shaped, and suspended by cord or resting upon supports, in either case easily removable.

The usual plan is to keep the birds in these cages for from a week to ten days, feeding them twice a day from the trough. Large numbers of birds are never crammed, but supply a demand for half-fatted chickens, and it is wise to keep this trade in view. The birds are considerably improved as compared with the lean specimens, and should command better prices. In many districts it will be well at first to supply half-fatted chickens until there is an inquiry for those finished off completely; and in summer there is very little demand for fully-fatted specimens.

The Sheds.—When the birds have been fed a week to ten days from the troughs, if it is intended to finish them fully, they should be removed to covered sheds, of which there is a great variety. Some are very rough indeed, and evidently built with the one idea of cheapness, whilst others are of a more complete type. In not a few cases barns and other buildings have been adapted to the purpose of fatting sheds, and where this is done they are loftier and warmer during severe weather than is possible with wooden erections.

There are, however, some fatters in Sussex who do not use sheds at all, but fatten entirely in the open air, giving such shelter as may be obtained from hedges and a rough board covering. At the establishment of Mr. J. Oliver, near Heathfield, long sheds are employed with open ends. Under ordinary conditions, it is found that the best results are obtained if the fatting cages are in single tier, because they can be more easily cleaned. In America, Hungary, and elsewhere, I found that cages were

Fig. 47.—Martin's Fattening Shed.

stacked in three to five tiers. Apart from the question of ventilation, unless the most rigid cleanliness is maintained, this system soon causes disease. Whatever the form of pen employed, it is necessary to remove the droppings daily, to limewash the house out frequently, and to treat the pens in the same manner between each occupancy. An excellent plan when cages are in single tier is to have a sloping board below the pens, sprinkling upon it fine earth and lime, and scraping it down daily. The use of powdered lime, Izal or other disinfecting powder, or a solution of permanganate of potash, is advisable, to destroy microbes. It is impossible to lay too much emphasis upon cleanliness in the fatting sheds and cages, whether in the open or under cover.

It is unnecessary to describe at length the various sheds in use, some of which are shown in the illustrations. These vary in size with opportunities and requirements. The main points are that they shall be well ventilated and not be overcrowded, yet protect the birds against exposure. During the process the chickens require an abundant supply of oxygen to facilitate digestion. It is here where many sheds I have seen in other countries fail. In fact, the great difference between the English method and those adopted on the Continent and in America is thus indicated. The largest fattening plant in this country is at Liverpool, where Irish birds are fattened to meet the requirements of the steamship

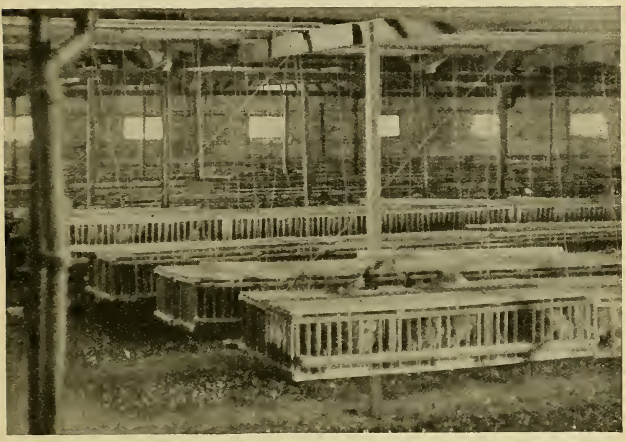


FIG. 48.—INTERIOR RUDDIN'S FATTENING SHED, LIVERPOOL.

trade. The shed consists of a large building formerly used for tramway stables, and has capacity for nearly 16,000 birds. As the illustration shows, the cages are suspended by wire strands from the roof, which facilitates the work of keeping clean.

Cramming.—The methods of fatting adopted are four in all: (1) From the trough; (2) by hand; (3) by funnel; and (4) by machine.

1. This method has been already referred to, and it is chiefly employed for the production of half-fatted specimens, which may either be kept in the ordinary pens or in a house and run, holding a dozen or a score of birds, which can be moved on to fresh ground as often as necessary. It is fitted with troughs

at either side. One of these appliances, 6 feet long by 3 feet wide, is large enough for a dozen birds, and it is a suitable form for ordinary farmers. In Belgium the famous Coucou de Malines are fatted entirely from troughs, but they are kept in closely-covered sheds during the entire process.

2. Some of the finest fowls which are produced both in England and France are crammed by hand. The process is, however, slow, so that it is only suitable where labour is abundant and cheap. In a large establishment it would be impossible to get

Fig. 49.—Interior of Fattening Shed.

through the work if hand cramming were depended upon. The food is mixed to a thick paste, and formed into pellets or boluses about $\frac{3}{4}$ inch in length and $\frac{1}{2}$ inch thick. There are two ways in which feeding takes place. In the one a sufficient number of the boluses are prepared, and the operator takes hold of the bird's head, either in the pen or out of it—in the latter case firmly gripping it between his body and left arm—opens the mouth with the thumb of his left hand, dips the bolus into a vessel of whey or milk, inserts it into the mouth, presses it down the throat with his finger, and then carries the food into the crop by running his finger and thumb down the outside of the gullet. The second plan varies somewhat. The operator sits upon a stool, with a lot of the paste and a bowl of whey or milk before him. The bird is placed upon his knees, its legs held firmly by them, the left hand holding the wings, and he places a small quantity of the food, after dipping it in the milk, into its mouth, allowing it to swallow in the usual manner, there being no actual cramming. Both these methods are very simple. In some instances a combination of the two methods is adopted.

3. Cramming by funnel is largely carried out in Southern Normandy. In this case the food is made into liquid form, about the consistency of ordinary cream. A specially-made funnel (Fig. 50), the nozzle of which is carefully turned to prevent injury to the bird's throat, is inserted into the gullet until the orifice enters the crop, which can be felt by the finger, and the food is spooned therein until the crop is full, when the funnel is withdrawn. In operation the process requires a much shorter time than it takes to describe, but care must be taken, or there is great danger of choking the fowl. These funnels can be purchased at a reasonable price, and splendid quality of flesh is produced in this manner.

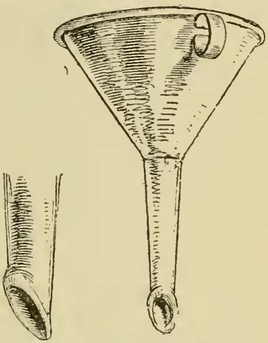


Fig. 50.—Funnel for Cramming.

4. Cramming by machine is found to be the most expeditious, and the first cost is speedily saved in the labour bill. An expert operator can feed 250 birds in an hour, so that the duration of insertion is very short. Many people have the idea that this system is a cruel one, but it is not so. A careless or inexpert operator can hurt the subject, but it does not pay him to do so, as any injury to the throat or mouth would cause inflammatory action to be set up, and it would die. The tube which passes down the throat is made of indiarubber, and, as the cartilaginous rings of the neck are flexible, it enters quite easily. The way in which the fowls anticipate the feeding-time, after the first day or two, shows how they regard the operation. The machines employed are—(1) the Neve (Fig. 51), which is largely used in Sussex; and (2) the Hearson (Fig. 52). In both the quantity of food can be regulated to a nicety, and the great thing is to cease pressure the

moment sufficient has been placed in the crop. A most important point in connection with the fattening of poultry is to give the food regularly, and if there is any remaining in the crop from the previous meal, not to give any at all. Several French cramming machines are made for liquid food, and attached to them is a long piece of indiarubber tubing, fitted with a spring top or nozzle, so that the birds can be fed in pens without taking them out, the liquid flowing when the spring is released. In this case the nozzle is only placed into the mouth, not passed down the throat. The

FIG. 51.—NEVE CRAMMER.

head must be held well up and the neck stretched to allow easy swallowing.

Food for Fattening.—The food supplied to the fowls during the process of fattening is of very great importance, and upon it must depend both the quantity and flavour of the flesh. This must always be soft food, never hard corn, as the latter would take longer to digest, from the fact that the birds are in confinement and would not give the same results. The reason why animals fatten better at rest is well explained by Professor Warington, F.R.S. He says that economy of food is promoted by diminishing the demand for heat and work. An animal at rest will increase in weight far more than an animal taking active exercise on the same diet. In the same way, the increase from a given weight of food will be less in winter than in spring or autumn, a far larger proportion of the food being consumed for the production of heat when the animal is living in a cold atmosphere. Hence the economy of feeding animals under cover during winter. If, however, the temperature becomes so high as to considerably

Fig. 52.—Hearson's Crammer.

increase the perspiration, waste of food again takes place, heat being consumed in the evaporation of water. The temperature most favourable for increase is, apparently, about 60° F. Quietness and freedom from excitement are essential to rapid fattening; the absence of strong light is therefore desirable.*

In Sussex and the south-eastern counties the food almost entirely employed is ground oats, which is largely prepared in the Valley of the Medway, millers there making a speciality of this product. There is no reason why it should not be produced

* "Chemistry of the Farm." London: Vinton and Co., Ltd.

elsewhere. It is necessary that the mill-stones shall be sharp and run very low. Ground oats must not be confounded with oatmeal, as they have not been kiln-dried—at any rate, to the same extent—but are fresh oats ground very fine, husk and all. The powder from oatmeal mills is often, however, used for this purpose. It is found in experience that English and Scotch oats are unsuitable for this purpose, as they contain too much moisture, and will not grind fine enough unless they are highly kiln-dried. Consequently the plump, hard Russian oats are preferred, and from them the best samples are produced. The usual price for pure ground oats ranges from £9 to £10 per ton, varying in accordance with the market rates for oats. Cheaper kinds are often sold, but these are usually adulterated with fine thirds, and it is better to obtain the purer, even though the cost may be higher. A mixture which is often employed consists of one part ground oats, one part fine Indian meal, and one part fine sharps, costing about £6 10s. per ton. In Belgium finely-ground buckwheat is universally used, giving good results, and in France buckwheat-meal and fine barley-meal are largely employed, both of which are very good; but by reason of the greater amount of lime in ground oats they produce the finest flesh.

Use of Milk.—With the meal should always be mixed soured skim-milk, butter-milk, or whey from the curds. In Sussex the first-named is alone adopted, and one of the largest fatters sometimes pays as much as £20 in a week for milk during the busy season. Whole milk is much more expensive. The globules of butter-fat in it are too valuable, and can be substituted at a much cheaper rate. Surprise is often expressed that soured rather than sweet milk should be used. In practice it is found that the former gives the better results, the acid generated by the turning of either milk, butter-milk, or whey, causing more rapid digestion than would be the case if it were sweet. Not only is the milk itself soured, but when mixed with meal, as is usually done immediately after one time of feeding is over, it is allowed to stand for several hours, until a slight fermentation has taken place. There are distinct disadvantages from the giving of soured milk, and one is that there is always a greater tendency on the part of the birds to scouring; but fatteners who have tried both systems declare that the soured skim-milk yields the better results, in that the birds will eat longer and digest their food more quickly than if sweet milk is employed, and at the same time there is less danger of what is known as crop-sickness. It is claimed that the acid generated in the milk has the tendency to prevent sickness, and also stimulates the appetite, and there seems to be a considerable amount of reason for this statement. A further advantage to the fattener is that he has not the same necessity to obtain his milk at the time when it is required, and, in fact, in many of the fattening establishments great vats of milk are allowed to stand for weeks before using, bought up as obtainable. Milk contains a large amount of phosphates, which have the effect of whitening the flesh. Not only is this true in respect to chickens, but also ducklings, goslings, and turkeys. The use of milk at the time of feeding off the turkeys before killing is found to result in beautiful colour of flesh. Milk is one of the most valuable foods we have, and in some parts of the country, the dairy districts especially, skim-milk is almost a waste product. Butter-milk does not appear to yield quite the same results. It contains a little more in the way of fat, and is somewhat richer, but, as already stated, it is employed in Belgium, and might be used wherever it is available in this country. The late Mr. Lewis Wright* made a very interesting suggestion as to soured skim-milk: "The sour milk keeps the digestive organs in proper activity, without the use of fresh vegetables, which would otherwise be necessary. Tell a Sussex fatter to use 'boiled milk' and the green food which would then be required, and see what he would say."

Feeding.—A question is frequently asked as to what influence the increase of fat upon animals and birds, which are specially fed for table purposes, has so far as the edible qualities are concerned. The contention, which is often put forward, that whenever fattening takes place there must be a certain amount of waste, cannot be questioned. It is impossible, when we develop the proportion of fat in the flesh, that we can confine this only to the parts of the body which are consumed as food, because the entire system is affected. In fattening, whilst the muscle is increased largely in bulk and weight, there is at the same time a considerable distribution of fat on the intestines and internal organs. It is equally true that the greater part of the fat which is added to the food during the preparation of table poultry is beneficial, in that the globules of fat are distributed through the muscles upon the body, increasing these in bulk, adding greatly to the weight of the bird, and at the same time improving both the colour and quality of the flesh. If we take any animal or bird in lean condition and feel the muscle, it is hard, whereas when the animal or bird has been fatted the muscle is soft, but more bulky. It is necessary that the muscle shall be what has been termed "soft."

* "New Book of Poultry," London, 1902, p. 121.

A recognized rule amongst both poulterers and cooks is that an old bird and a lean bird should never be roasted, but always boiled. The reason for this recommendation is that dry heat, by withdrawing from the muscle the moisture contained therein, leaves the tissue hard and fibrous, and consequently less palatable, whilst it is distinctly inferior in digestive properties. The action of the water during boiling is to soften the flesh by soaking, and rather to increase the bulk as a consequence of the absorption of moisture into the flesh. When a bird is in fat condition, however, it is found that the action of even dry heat does not have this effect, in that the globules of fat distributed through the tissue, by melting retain and increase the softness of that tissue. For that reason cooks lard certain kinds of meat during the process of cooking, in order to retain the moisture and to prevent the escape of the natural juices. Otherwise our meat would be dry throughout, the same as it is on the outside, and we know very well that this would reduce its nutritive properties, and at the same time make it more difficult of digestion. Even with fat birds, when they are placed in dry heat, there must be an amount of evaporation; but that is not an evaporation of fat, only of a proportion of moisture in the fat, the oily property still remaining in the flesh.

Fat is not mixed with the food whilst the fowls are fed from the troughs, but when put on to the crammer $\frac{1}{4}$ ounce should be allowed for each bird per day, or a tablespoonful for every ten fowls, gradually increasing it to double that quantity. Fat may be bought in barrels for this purpose ready for use, but in most of the larger towns butchers' scraps can be purchased at a cheap rate, and should be clarified and stored ready for use as required. It must, of course, be melted and thoroughly mixed with the meal and milk. Sometimes it is found necessary, especially during hot weather, to take steps for keeping the blood cool. A little flowers of sulphur is useful to this end. Some fatters boil nettles, and, after chopping them up, mix with the food.

Fowls should always be fed twice a day, and at regular times. The exact hours will vary in accordance with the season of the year. In summer seven o'clock in the morning and six o'clock in the evening will be found the most suitable, but in winter eight in the morning and four in the afternoon will be better. In this case the evening meal should be rather fuller than that in the morning.

Frequently it is found that birds when first put up fret by reason of the confinement, and, instead of putting on flesh, actually lose weight. To prevent this, they should be kept without any food for the first twenty-four hours, or, if they have come a long journey, for the first twelve hours, by which time they are so eager for food as to forget about anything else. They then take a hearty meal and are content. Or a little broken maize may be spread on the top of the food in the trough in order to tempt them to eat. Coarse grit added to the mixture will be of benefit. When trough-fed, all that remains must be taken away as soon as the birds are satisfied. Some fatters feed only once on Sundays, which is found to do no harm, though that is usually a question of labour.

Feathers and Manure.—Where larger numbers of fowls are fatted, the feathers and manure form important items, and should be carefully collected and disposed of to the best advantage. Fatters have informed me that they were able to pay their wage-bill by the sale of these articles. Feathers should be sorted and dried; manure must be kept dry and under cover, and it is in demand by market-gardeners, selling at from £2 10s. to £3 per ton. If the fatting establishment is run in connection with a fruit or ordinary farm, an outlet will be found for it in this way.

Killing Fowls.—All classes of poultry should be kept without food for twenty-four hours before they are killed, the object of which is to empty the crop and intestines. Partly digested food rapidly decomposes after the bird is dead, and if left there a great amount of loss arises as a result. This is frequently indicated by a green appearance of the skin over the crop, due to chemical action, which reduces the value considerably, as the flesh also is affected, more especially in warm weather. Not alone is this denial of food most important, so that the bird will keep for a longer period, but also it will be much easier to draw. No cruelty is involved, as the body reserves would enable it to live for several days without any food whatever.

Killing fowls is by no means difficult. One method is to hang the birds up by the legs, and then thrust a pointed knife into the roof of the mouth, rather in a backward direction than to the top of the skull. This is in order to reach the brain, for then death ensues very speedily, and with very little pain to the victim. The birds should be allowed to hang until the blood has ceased running, and be plucked immediately. In all cases where fowls are killed to be sent to market they should be plucked by the farmer, and the value of feathers he will obtain will more than repay the labour of plucking, though this is not its object. A special knife should be employed; Spratt's Patent sell one very suitable for this purpose.

Dislocation of the Neck.—The common method of killing fowls is by dislocation of the neck, and there can be no question that in the hands of an expert operator this plan is most expeditious, and with the minimum of pain to the victim. It is not easy to follow the method from a printed description. The bird should be held firmly by the legs in the left hand, which can grasp the ends of the wings also, the head in the right hand between two of the fingers back of the skull, so that the comb lies in the palm, the back of the bird upwards. The legs are then pressed against the left hip, and the head laid against the right thigh near the knee. Next the fowl should be rapidly and firmly extended or drawn to its full length, and at the same time the head is suddenly bent backwards, by which means the neck is dislocated just below the junction with the head, and death immediately ensues, as all the large vessels are torn across. The operator must not be nervous, nor yet afraid, performing the work firmly and expeditiously. Muscular action will take place for a few minutes, but if the operation is effective no pain is suffered. It is always better to pluck whilst the fowl is still warm, as the feathers then come out easily and the skin does not tear. There is no cruelty involved by doing so, for all sensation is at an end, the brain, which is the centre of all feeling, being completely severed from the body. In plucking, the operator should sit down, hold the legs in the left hand, the head hanging between his knees, so that the blood flows towards the head and gathers in the neck, without making any mess. It is better to draw the feathers with an upward pull—that is, the opposite way to which they lie on the body. An expert operator can kill and pluck twelve birds per hour.

Shaping.—Shaping is carried out in Surrey and Sussex as part of the process, and is one reason why Surrey fowls look so much superior to those not finished off in the same manner. This system is, moreover, so simple that it can be adopted at very small expense, shaping boards being very easily made. Fig. 53 shows one built in three rows, capable of holding thirty to thirty-six birds at one time. For smaller producers it can be built with one row, and the cost of material for construction of the larger size would not be more than four shillings. Each trough is made V-shaped, the front of which is rather narrower than the back. These troughs consist of only twelve pieces of wood—namely: (1) The two upright ends, 36 inches by 7 inches; (2) three troughs, each made of two pieces, at right angles, the back board 6 inches wide and the front 5 inches, and 30 inches long; (3) the bottom stay; (4) three loose boards, $\frac{1}{2}$ inch shorter than the troughs and 4 inches wide. It is better to use plain deals $\frac{5}{8}$ or $\frac{3}{4}$ inch thick, and fit the whole firmly together.

The *modus operandi* is as follows: As soon as the birds are plucked, which should be done carefully and thoroughly, the hocks are tied loosely together, so that the legs are flat against either side of the breast. Before doing so, however, some of the more skilful fatters draw the meat upwards by means of the hands, which undoubtedly improves the appearance of the bird, though it must be done carefully to prevent breaking of the skin. The

Fig. 53.—Shaping Board.

operator strikes the stern against a wall, thus flattening and making it fit the shaping trough more easily. Each bird is laid in the trough breast downwards, with the neck and head hanging over the front. The first bird is pressed firmly against the end of the trough, and a weight or glazed brick laid by the side to keep it in position. When the second and succeeding birds are placed in the trough, the weight is moved along until quite full. It is necessary that they should be packed firmly and tightly in this way. Next a loose board, 4 inches wide, and $\frac{1}{2}$ inch shorter than the trough, is laid upon the back of the fowls, just behind the wings. Upon this are placed three or four heavy glazed bricks, or two weights (56 pounds for preference), and the fowls are allowed to remain in the trough for several hours—in fact, until they are quite cold and set.

Stubbing.—Whatever the system of shaping adopted, it is necessary that the bird be plucked carefully, and it is customary in some parts to employ the services of persons called "stubbers." If any of the feathers, and especially the short quills, are left in the flesh, they will, of course, materially depreciate the appearance. We desire to urge upon every producer the duty to himself and the industry at large of turning out the fowls in the very best manner possible. Some fatters are very fond of breaking the breast-bone of fowls, and this is frequently done in Sussex. It is a most objectionable practice, and one that ought never to be adopted. As a rule, all Surrey and Sussex fowls are singed immediately they are plucked and stubbed; and when properly done this custom is most desirable, as it is simply clearing

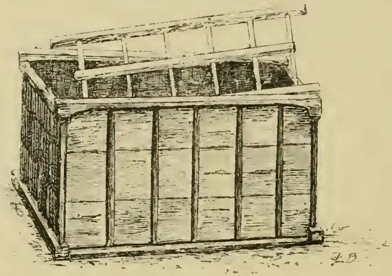


Fig. 54.—Sussex Packing Ped.

the skin of surplus hair and feathers. The flesh must not be blacked. Straw alone should be used.

Packing.—Much carelessness is shown in the packing of dead poultry, which needs especial care. I have seen crates of chickens opened, and their value materially reduced by reason of bad packing, many of the birds being "barked" or otherwise damaged. These ought to be packed firmly and evenly, and if this is done they will carry long distances in perfect safety. In this country specially-made crates, or "peds," as they are called, are employed, which combine lightness with strength. These (Fig. 54) are lined out with straw, with layers of the same material between each row. The birds are placed with the sterns to the sides, and in double rows. In France linen cloths, which are first dipped in milk, are often employed, and for the better class of fowls they are to be recommended. It may be mentioned that some of the railway companies are willing to supply hampers free of charge for conveyance of dead poultry.

In order to obtain the best results, chickens should always be killed where they are fatted, otherwise much of the benefit obtained by the system will be lost. A fatted fowl will lose a considerable portion of its added weight if sent to market alive, due to the change of condition. The same thing is found in connection with larger stock. In these days of refrigerating chambers there is no difficulty in keeping dead poultry for several days, in order to avoid glutting the market.

Caponizing.—Before leaving this subject, it is important to deal with the question of caponizing. There can be no question that the system of caponizing is one that deserves considerably more attention than it has ever received in this country. If for no other cause, it could have been reasonably expected that pecuniary motives would lead farmers and large poultry-keepers to adopt the system; cockerels caponized, and pullets made into poulardes, grow to a very much larger size than those not so treated, and it is true that the quality of the meat is much improved; not only so, but male birds which could not be kept together without great danger of constant conflicts will live in peace and amity. Upon the ground of profit, it is strongly recommended that all male fowls intended for table in the autumn should be caponized, because the surplus cockerels can thus be made the most of, and will realize for the breeder more than they otherwise would.

The best birds to operate upon are chickens which have never yet crowed, and when about eight to twelve weeks is the right age. They must be kept without food for thirty-six hours or more before being operated upon. A good light (sunshine, if possible) should be chosen to operate in, and the full light should be allowed to shine in the chicken's side when opened. First take two good thick pieces of string or thin cord 3 feet long; to one end of each attach a weight, or any equivalent in the form of a brick or stone, fastening the other end of the string to the chicken's legs. Then lay the bird on its left side, and drop the weighted end of the string over one side of the operating-table. Now tie the free end of the second string round the bird's wings near the body, and drop the weighted end of this string over the other side of the table. The chicken will thus be properly secured, and the operator must stand so that its back will be towards him. The small feathers from hip-bone to ribs, over the last rib, must now be plucked off, and the ribs and feathers all round should be wetted with a sponge dipped in quite cold water; or ice can be used if preferred. This wetting will serve to keep the feathers out of the operator's way, and will also numb the sensations of the fowl, so that it does not appear to feel the operator's knife. Stick the knife in ½ inch deep between the first and second ribs from the hip-bone, and cut downwards and forwards to the end of the ribs. Turn the knife, and cut nearly up to the backbone. Now put in the spreader, which is one of the instruments used, tempering the tension by a rubber band provided for the purpose to suit the size of the fowl, and with the spreader open the ribs, after which split the inside striffin that covers the bowels. The upper testicle will now be exposed, and should be grasped by the grippers, which should be given one entire turn over so as to separate the testicle from its attachments, except the spermatic cord, and pull the testicle out. Treat the lower testicle in the same way. It is necessary to be careful not to rupture the large vein under the testicles, and also to get the whole of the latter out. The bird may be untied and allowed to go without the incision being sewn up, but for a few days it should not be allowed to fly up to roost. Birds may in this manner be caponized in any number, and without loss of more than 1 or 2 per cent. Large breeds of poultry, when caponized young and well fed until ten or eleven months old, and then fattened, will weigh 10 to 15 pounds each, and the meat on them will be found of the tenderest and most succulent description.

It is to be noted that the chief dangers found in practice with all systems of caponizing is in tearing the veins near the testicles, which results in the bird's bleeding to death, and in the losing of the testicles amongst the intestines, which latter is almost certain to cause inflammation and death. These seldom happen, except through want of care or inexperience, but it is important to have a good light in order to prevent it as far as possible.

Dressing and Trussing.—Fowls which are being marketed in the usual manner must never be drawn or cut in any way, as the final work is performed by the poulterer in accordance with his customer's requirements. When chickens are sold direct to customers, it is better if they can be delivered ready for cooking. Cooks are not nearly so expert at this business as they were formerly, and, further, they naturally prefer to have a bird which does not entail the labour necessary if it is sent undrawn. In some parts of the United Kingdom the method adopted by poulterers is by no means the best, and the following explains, as far as possible in print, the system which gives the most satisfactory results. For this purpose a special knife is required, and a trussing needle

A Belgian Carpenter's Flock of Malines.

(12-inch preferred, as then it can be used for turkeys, which are trussed in the same manner), and some fine, strong string.

Milk Chickens, or Petits Poussins.—Milk chickens are very young birds, usually five to eight weeks old. They go under the same designation in Belgium, where they are more popular than with us. In France they are called *petits poussins*. To a somewhat heavier class of bird in America is given the name of "squab broiler." So far as the great mass of consumers is concerned, this class of chickens are practically unknown, simply by reason of the fact that they are too expensive. The customary plan is to serve one to each guest, and at great houses. the chef brings them round as the *pièce de résistance* of the feast. When plump and well cooked, these occupy the place of the most delicious dish that can be obtained among all the various grades of poultry, as the flesh is beautifully tender, and wonderfully abundant if the birds are killed at the proper stage.

Attempts have been made from time to time to introduce the raising of these milk chickens in this country, but except here and there the business has not grown to any extent. Some years ago an effort was made to establish a so-called chicken farm in Belgium, where *poulets de lait* could be turned out by the thousand, reared upon shelves. That did not succeed. The mortality on the one side and the expenses on the other were too great to allow of profitable continuance.

Formerly the majority of milk chickens sold upon our markets —that is, in London; for the demand in provincial centres is very small indeed, and uncertain at that—were imported from France. In the Seine-et-Oise department of that country large numbers are reared, as the demand in Paris is considerable. Probably all the best specimens are still derived from there, and in flesh qualities these are superior to any others.

Within recent years the greater portion of the milk chickens upon our markets have come from Germany, and as they reach us through the port of Hamburg that name is given to them. The districts in which they are produced are found in the provinces of Oldenburg, Hanover, Schleswig-Holstein, and around Lubeck, near the Dummer See. The production is very large indeed. Within one comparatively limited area in Hanover, near to the little town of Winsen, it is estimated that 300,000 to 400,000 are bred and killed every year, the great majority of which are despatched to London. This is a great corn-growing district, and a considerable number of the farmers produce a few hundreds each every year; whilst a fair proportion of the labourers and their wives add to their incomes in this manner, thus supporting what has been stated previously—namely, that it is a means of adding to income, not a business by itself. As the chickens are sold for killing when five to seven weeks old, the prices obtained, varying from 9d. to 11d. each, leave a fair margin of profit for the labour involved, as it is well known that, inclusive of cost of egg and food, they can be raised to that age at 4d. to 5d. each, provided, of course, there is no heavy mortality to reduce the returns. That has been avoided from the fact that the rearing is well distributed, and the quantity named is due to the work of a large number of individual breeders.

Here is the secret of success. As in the case of the Sussex production of table chickens, the primary stages of the work are in many hands, and only the final stage concentrated. To that end it is requisite that there must be uniformity of operation within an adequate area, in order to insure a sufficiency of supply. Isolated action is useless, unless it be on a very large scale. The birds, when ready, are sold to dealers, who undertake the work of killing, plucking, and marketing.

Spring Chickens.—From April to early June there is a very large demand for what are known as spring chickens—that is, birds eleven to fourteen weeks old. As a rule these have not been fattened in the manner described above, but simply fed for a couple of weeks before killing on food in which soured skim-milk is used freely. It is entirely a question as to whether these birds have been kept growing all the time, and are killed at the right age. Immediately prior to the time when the birds cast their chicken plumage and the sexual instincts will be more fully developed, the body will be found heavier, the flesh more abundant and softer than will be the case afterwards, until three to four months have elapsed. That is the time they should be killed, and if of the right breeds will weigh from 2 to 3 pounds. Such birds do not need fattening, except what has already been stated, and usually command good prices. In fact, sold at 2s. 6d. each they are probably more profitable to the producer. They must, however, be marketed during the months mentioned, as the prices are lower later.

Winter Fowls.—During the autumn and winter months there is a fair demand for larger birds weighing 7 to 9 pounds, for which good prices are paid, though the trade has not been developed in Britain to the same extent as in other countries. Such have always formed an important part of poultry husbandry in France, notably in the Bresse country and in Normandy, where the splendid fowls marketed at Christmas and Mardi Gras (Shrove Tuesday) are among the finest I have ever seen. Although large in size—I have seen a couple of La Flèche weighing $23\frac{1}{2}$ pounds dead—they are beautifully soft in flesh, which is very abundant. That is true of the Bresse, du Mans, and others. The secret is to keep the birds growing and to fatten off in the best manner. Most of the cockerels are caponized, but the perfection for flesh is the French *poularde*—that is, a pullet which has never laid an egg.

Poulets de Bruxelles.—In Belgium a great industry has been developed in the provinces of East Flanders and West Antwerp, which will be found fully described in my "Report on the Poultry Industry in Belgium." Unfortunately, the districts referred to have been devastated by an epidemic, as a result of which hundreds of thousands of chickens have died. This has been entirely due to the false methods adopted in connection with the conditions under which the stock has been maintained, to the false systems of breeding, hatching, rearing, and feeding, during the earlier stages. So long as those who reared the birds did so on open ground, giving both parents and chickens liberty, all went well. With increase of numbers and concentration upon limited, manure-tainted areas, the result has been what is stated above. That will always be the case when such methods are adopted, as these are destructive of natural vitality, and birds want all that they can possibly conserve. I am firmly convinced that this industry can regain its former position, provided the extensive system is resumed, and the false methods followed of late are abandoned, making the poultry part of a rotation, and not keeping birds on the same ground year after year consecutively.

Usually, these Malines fowls, or *poulets de Bruxelles,* as they are called, are from five to eight months old. They carry an abundance of excellent flesh, which is fine in texture and white in colour. The trade done with Germany is a very large one, and was, until this outbreak of disease, very profitable to all concerned.

American Soft Roasters.—In the State of Massachusetts I visited a section, to the south of Boston Bay, where a similar branch of poultry husbandry has been developed with great success, for the supply of Boston and other markets. In the work a considerable number of raisers are engaged, each of which sells from 3,000 to 6,000 chickens a year. The breeds used for this purpose are the Light Brahma (American type) and the

White Plymouth Rock, both of which, although slow growers, develop big frames. The farms upon which the work is done are usually about 40 to 60 acres; the land is light and somewhat poor, but there is a good deal of scrub upon it. The colony house system is very general, both for breeding stock and older chickens. In a few cases long-range houses with divided yards are used for breeding stock, but the chickens are raised in scattered colony houses. It is customary to plough up the land each year and plant with rye grass. Both natural and artificial methods of hatching are employed, chiefly the latter, and the chickens are reared in brooder houses until they can dispense with heat, when they are placed in colony houses. Here they are kept in flocks of fifty until sold for killing. These houses are 7 feet by 6 feet, with netted fronts. The inmates are given free range on the scrub land, of which not more than 10 acres are used at one time; and as it is only occupied for seven months of the year, when vacated it is cropped to utilize the manure and sweeten the soil. The method of feeding is simple in the extreme. Hoppers are kept both in the brooder and colony houses, containing cracked Indian corn, wheat, and beef-scrap. At one time Indian corn was largely employed, but several of the feeders are finding that wheat gives better results. In some cases dry mash is supplied, more especially during the later stages. Cabbages are freely given, and rye grass, when available, is eaten by the birds, who have a plentiful supply of fresh water. It is claimed that under this system the birds make steady progress, retaining the softness of flesh which is regarded as essential. For the smaller roasters, in demand during the spring and summer, White Plymouth Rocks are said to be the better, as they grow quickly and make 5 to 6 pound specimens. But for the winter trade, when 8 to 10 pound birds command the highest prices, the slower-growing Light Brahma is preferred. The cockerels of the last-named are always caponized. It may, however, be mentioned that these South Shore Roasters are sold alive by the breeders, and that the final work is done by specialists, who kill, pluck, and sell. There is no actual fattening, for the birds are selected as they come into plump condition. These sell wholesale on the markets at 1s. 2d. to 1s. 6d. per pound, and retail at 1s. 6d. to 2s. per pound.

In France, Belgium and America success depends upon the industry being that of a district, as is the case in our south-eastern counties. I am convinced there are great opportunities elsewhere for creation of similar district industries, and that a greater demand can be created for winter fowls.

The Paynter Method.—An experiment has recently been made on behalf of the English Board of Agriculture, with the object of showing that chickens could be profitably raised by small holders on intensive lines, but up to the present has not been determined. The idea was that of Mr. F. G. Paynter, who has devoted himself to this question for several years. He claims that, on a holding of, say, 16 acres, 4 acres should be used each year for chickens, and by changing the area form a four-course rotation. Thus 12 acres would be under crops each year, which, if properly cultivated, should yield a substantial profit. In the experiment referred to, all the eggs were purchased, hatched in incubators, the chickens raised in brooders, and the birds sold alive at twelve to sixteen weeks old. The poor averages in hatching, the heavy mortality, and the high cost of feeding, made the profits small for the cost and labour involved. Whether further tests will show a better result remains to be seen. Were that possible, a new field would be opened.

Shelf Brooders.—More than twenty-five years ago I visited Germany to inspect a farm in the Metz district, where an attempt was being made to hatch chickens artificially and rear in rooms of an old château. That was a failure. In America I saw tests being made with the same idea, but the birds were kept on shelves. More recently a large amount of money was lost in England in the same way on two occasions. In all the difficulty was identical—namely, that the mortality was excessive. There is and must be no finality in poultry husbandry. At the same time, those to whom profit is essential will be well advised to leave such speculative methods to others who have money to burn, until these have been proved.

CHAPTER XVIII

THE DUCK INDUSTRY

In no branch of poultry husbandry have there been greater developments, equally in Europe and America, than production of ducklings, which, whilst not likely to attain the same prominence as egg production or the raising of chickens, is of considerable importance. A noteworthy feature is that it has proved successful both in the hands of smaller men and where extensive operations are carried out, as described below. In the former case, as a rule, the object is to produce birds to meet a seasonal demand, for which high prices are obtainable. That is specially the case in England, Belgium, and France. Although this section of the industry has not grown to any great extent, it is of considerable value, economically and socially, in that a large number of breeders thus obtain a partial or entire livelihood. During the spring months of the year there is a profitable demand for ducklings at what may appear excessive prices, which leave a considerable margin of profit. Where operations are conducted on a more extensive scale, the general demand is supplied, usually at a later period, when rates are not so good. That there are limitations to the possibilities of this trade cannot be controverted, even though these are not yet in sight. A duckling forms an expensive dish which is beyond the means of the great mass of householders, especially as the amount of flesh upon it is comparatively small. Ducklings are birds nine to twelve weeks old, in accordance with the breed, killed prior to the time when the duckling feathers are cast and the adult plumage assumed. On fully-grown winter ducks the flesh is usually abundant, and in some breeds fuller in flavour and higher in nutrition than is the case with that of ducklings. I question, however, whether these can be produced profitably, as ducks are heavy eaters. Duck-breeding is a highly specialized business, needing considerable skill. Those who undertake it should proceed cautiously, and in accordance with their experience.

Aylesbury Ducklings.—At one time this branch of poultry husbandry was almost entirely restricted to Buckinghamshire, of which the Vale of Aylesbury was the centre. Within recent years it has extended into Bedfordshire and Oxfordshire, so far as that section of the country is concerned. Now in Norfolk, Suffolk, Lancashire, Lincolnshire, and in Cambridgeshire, duck-raising on advanced lines is to be met with. The pre-eminence which once marked Buckinghamshire, Bedfordshire, and Oxfordshire, is no longer theirs, although the highest-priced ducklings are sent from the three counties named. At one period it was contended that there were some special virtues in the district, more especially the gravel found in the celebrated vale, which explained the quality of the ducklings. That, however, is without justification. The duckers of Bucks believed that they need not fear any competition, and, finding the industry a profitable one, refused to advance with the times. It was not for many years after incubators had been successfully operated for duck-hatching in other parts of the country that the duckers would even consider the desirability of adding to their productive power in this manner. Many of the younger men have recognized the necessity for progressive methods.

Selection and Breeding.—The first point to be regarded is selection of the stock birds, which is of great importance, not only with regard to breed—though that is a most necessary consideration—but also as to age and time of hatching. For early ducklings there is nothing better than the Aylesbury as a pure breed. It is a rapid grower and fattener. A cross, however, between the Aylesbury and Pekin, using a Pekin drake to Aylesbury ducks, is often found hardier. It is important to obtain the ducks good and from an undoubted source, so that they may be pure. They should be large, well-grown, and early hatched.

Early Breeding.—One of the most important points in connection with duck-keeping is securing the best prices by having ducklings placed on the market early in the season. In order to do this they must be bred early; but with many duck-keepers the difficulty is to obtain eggs in late autumn and early winter. If ducks or other fowls are allowed to breed when they like, if the stock ducks are themselves late-hatched, if they are fed carelessly, in all probability eggs will not begin to appear before March, when it is altogether too late to hatch spring ducklings; therefore those who desire to be successful in the production of ducklings for spring marketing should proceed to work in the autumn. That the business is a profitable one cannot be doubted. It is estimated that about £70,000 is annually paid to the duckers of the Aylesbury and Leighton Buzzard districts for ducklings. Ducks are very hardy, and will thrive almost anywhere if they have a reasonable share of attention; and as good prices can be obtained in the great towns of Britain, there is a large margin of profit to the producer.

Methods of Duck Farming.—Large numbers of ducklings can be reared on a small area, as the whole period from the time of egg production to killing should be comprised within three months. Moreover, these birds can be raised very thickly, and thus there is rapid overturn. It is no uncommon thing for 1,000 to 1,500 ducklings to be reared on a single acre of land, and within a period of six to seven months. The chief danger under conditions like these is that the land should become so charged with manure that there is not time for exhaustion of the ammonia before another season comes round. We believe that, to some extent at any rate, the fact stated explains why many duckers in the Aylesbury district have not succeeded to the same extent as was the case formerly; and, for reasons which will be afterwards explained, the land occupied during one season by ducklings should not be so used again for three or four years. In the meantime it should be heavily cropped. I have no desire to discourage small poultry-keepers—indeed, the reverse—but it must be pointed out that there are limitations imposed by Nature which we must attempt to break through. Consequently duck-raisers should not occupy the whole of their land in any one year, but be able to move on to fresh ground from time to time. For this reason small holders and farmers should succeed better than cottagers.

Supply of Eggs.—It will be realized that under such intensive conditions as we have already mentioned the keeping of stock birds would do much to restrict the space available for rearing, which explains why as a rule in this country duck-raisers do not keep breeding stock. In the United States the plan is not followed, for upon the great farms met with in that country breeding stock are kept and the ducklings raised. The plan here recommended—namely, of securing eggs from breeders—is to be preferred, as there is less danger under these circumstances of enfeeblement of the stock or of overcrowding the ducklings. It is to be remembered that stock birds must have liberty and water. When we say they must have liberty, that applies more to the question of water than of land. The system of buying eggs is almost universal throughout the ducking districts, and that plan has been followed also by Mr. P. Walsh, of Fleetwood, to whom references are made more fully later on. Under the system referred to, the breeders secure good prices for their eggs, and thus the business is profitable to them. Unless stock have sufficient exercise, we should not expect them to produce eggs with strong embryos, which is the most important point. Reliable ducks' eggs command good prices. In May 2s. per dozen would be a fair price for ducks' eggs, but in December 12s. per dozen is frequently paid. That is a matter of supply and demand, though the value of a duck's egg in December is also measured by the fact that the possible duckling within it may be worth 7s. or 10s. in May, whereas one hatched in April would not realize more than a third or a quarter that sum. Contracts for eggs are often made at 3s. to 3s. 6d. per dozen for the entire season.

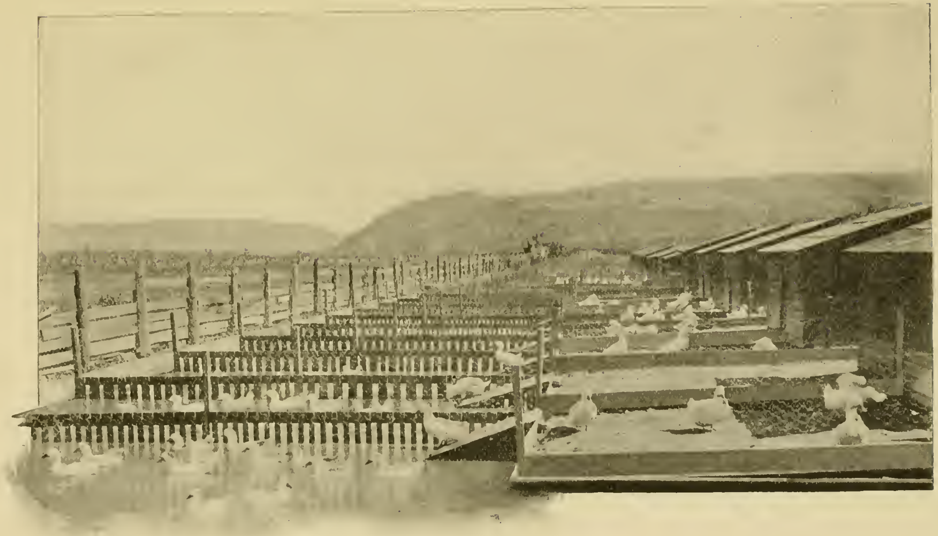
Hatching and Rearing.—The hatching hens are accommodated in outhouses and sheds, and often 150 hens may be seen at work in maternal duties at one time. Every day they are fed and the nests examined, but this is simple compared with the labour involved at the end of four weeks, when the young ducks begin to appear. As already stated, incubators are now used to a considerable extent. Ducklings have one special characteristic, in that they need little brooding, so that the progeny of half a dozen sitters can be placed under charge of one hen, and proud she will be of her large brood. From the very first the feeding has in view development of flesh and not bone. Consequently only those meals which are strongest in flesh and fat formers are used. For the first few days hard-boiled eggs (infertiles), rice, and bread, are given, after which barley-meal, mixed with scrap or tallow-cake, grains, and toppings, form the staple diet. On such feeding as this the growth is simply marvellous—they can be seen to grow. Kept in batches of about fifty, they are fed with the greatest regularity, and it must not be forgotten that in every pen is placed a trough of the famous gravel found in the Vale of Aylesbury, for which almost miraculous powers are claimed. To it is attributed almost all the merits of the Aylesbury duck—quality of flesh, rapidity of growth, and delicate pink of the bill, which is one of its distinctive marks. The birds appreciate this grit, and duckers use large quantities of it. Some of the ducklings sent to market have never known what it is to be in water, but as a rule they are now and again permitted a bathe or a swim. The pens in which they are kept are none too large, but there is reason in this, and fresh straw is supplied every day, their greatest enemy being cramp, to which they are very subject if exposed to draughts or the place be too damp.

The skill of the feeder is exemplified by the rapidity with which he can have the ducklings ready for market. They are heavy eaters, and every day of life means a serious addition to the cost. Further, the earlier they are ready, the more certainty of securing the best market, and the vacating of space for other batches. The majority of the ducklings sent from Aylesbury are seven or eight weeks old, but it is possible to have them ready at six weeks. They must be killed as soon as they are ready, and not kept a day longer than the hour when they are ripe, or they will go rapidly back. Killing and plucking are carried on at great pressure, for it is no uncommon thing for a ton of ducklings to be despatched from this district in a single day. This would represent about 7,000 birds per month.

Houses and Sheds.—The arrangements made for the housing of the adult ducks must necessarily depend upon the opportunities of the breeder. Where space is limited, and there is small fear of injury being wrought by the birds, they may be given full liberty and allowed to wander where they like. Under these circumstances the houses can be scattered about in the most convenient places. A duck house does not need to be as lofty as one for chickens, because ducks sleep upon the ground. For a breeding pen of thirteen birds—that is, ten ducks and three drakes, which may be all kept together—a house 6 feet by 4 feet 6 inches allows plenty of space. This house may be either gabled or a lean-to, and it should be thoroughly well ventilated; in fact, the front is better if it is made with wire netting, so that it can be left open. Where the birds must be kept within a measure of confinement, a house should be placed in the neighbourhood of running water or a pond, and yards enclosing both water and land can be arranged.

A mistake is frequently made in placing the houses too near the water, and a great amount of cramp in the breeding stock results. The house should be upon thoroughly dry soil—dry, that is, even during the winter or wet season—because we must bear in mind that although ground may be some distance from the water, yet percolation means that, unless the place where the house is located is considerably above the level of the stream, it will be damp. Around the house should be an enclosed yard, which may be made of 2-feet wire netting or of low hurdles. The object of this is that ducks, if they have the opportunity, will lay anywhere rather than in their house, and frequently on the water. That can be prevented by keeping them within the enclosed

PLATE XIII.



Breeding Pens for Ducks.

yard until 10 or 11 a.m., by which time nearly every bird that is going to lay that day will have produced her egg. Under the conditions named, duck-breeding is of the simplest character, because the birds have plenty of water to drink, and they can be fed the same as ordinary poultry.

Feeding.—The treatment of ducks when mated is of great importance, for all preparations will be useless unless there is a supply of eggs. Food given must be good and plentiful, but certainly not of a fattening nature, or the ovaries will become so clogged that the birds will be unable to produce eggs; hence Indian corn should not on any account be used, except in very small quantities, because of its fattening quality. The staple food should be barley-meal, mixed with about half its bulk of thirds or pollard if the barley-meal be good and floury; but if it be of commoner quality, then so much of the thirds need not be used. Butcher's offal, liver, and scraps, are all good, if well boiled, chopped fine, and mixed with the meal. But where these are not available, or in too limited quantities, there is nothing better than tallow greaves, or scrap-cake, as it is called in some places, for it is rich in the elements required. It should be broken up and boiled or simmered for a couple of hours until it is quite soft, when it and the liquor in which it has been boiled should be mixed with the meal. Another excellent plan is to make a contract with hotels for taking their waste scraps, which can generally be done on satisfactory terms. Whatever is used in this way is better boiled, and then mixed with the meal. It is important, however, to warn against use of diseased meat, which ought never to be employed. Some duck raisers give boiled horse-flesh to their birds, and if sound nothing can be better; but so many horses obtained in this way are diseased that it is necessary to utter a warning against their use. Of course, meat given must not be too fatty. If fed judiciously, meat will give that necessary stimulus to the egg organs that is needed in winter, and yields elements required for a constant supply of eggs. The meal should be well and thoroughly mixed, adding as much boiling water as is required to make it into a crumbly mass, for on no consideration must it be given sloppy. It is better to feed from troughs, as this prevents waste of food, and what is left can be removed when the birds are satisfied. Stock ducks ought to be fed twice a day—first, as early as possible in the morning, and, second, about an hour before they retire for the evening; the former should always be as soon after daylight as can be. It is an excellent plan to throw a handful or two of oats into the water in which the birds swim or bathe during the day.

The "Walsh" System.—What has been stated above applies to the methods usually adopted where operations are on a modest scale, in the hands of individual producers. It now remains to describe a large duck farm upon which the methods are entirely different. It has been in operation for more than twenty years, entirely upon utility lines, without any contributory returns in the shape of sale of stock, eggs for hatching, etc. The whole business is in the hatching and raising of ducklings for market. This is owned by a Lancashire farmer, Mr. Peter Walsh, and is situated near Fleetwood. The soil is a clay loam, slightly undulating, and windswept, as it is within sight of the Irish Sea. As may be expected under such conditions, very early ducklings are not obtained, nor birds of the highest quality. The limitations of the environment are fully realized.

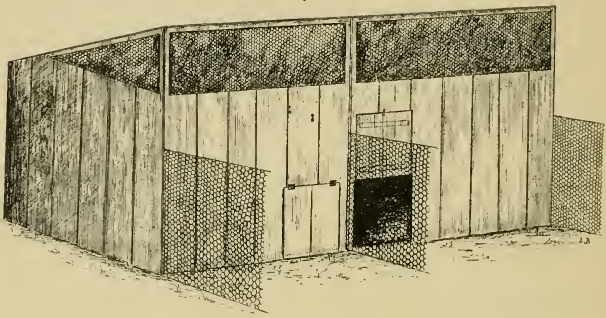


FIG. 55.—DOUBLE REARING HOUSE FOR DUCKLINGS.

This farm consists of 25 acres, on which, as no breeding stock are kept and the rearing is intensive, the same ground is not used in successive years. The farm buildings are substantial, providing accommodation for offices, incubator rooms, stores, plucking shed, and chilling-rooms. Everything is of a rigidly practical nature, plain, simple, and inexpensive, almost to a fault. In fact, cheapness is evident everywhere, save in the incubators and chilling plant. Not a penny is spent that can be avoided.

No breeding stock are kept. Thus the land is available entirely for rearing. The eggs purchased number about 60,000 per annum, derived from many sources and districts. Such method has many disadvantages, in that supplies are often unreliable and uncertain, and there can be no control over the class of bird from which eggs are obtained, which means inferior quality, as the district does not produce more than a moiety of eggs required. On the other hand, the maintenance of 800 breeding ducks is avoided, which would otherwise be required, and the risks of tainted ground obviated, as is the saving of labour. It is a question of economics, and in this case the balance is thought to be on the side of the present system.

Methods of Rearing.—The hatching is entirely artificial. The machines, of which eighty are in use, are accommodated in two large rooms, with a total capacity of 14,000 eggs. These are closely packed together in rows, standing upon wide benches with tray rests in front and passages between. Great attention has been paid to ventilation by sliding shutters below the level of the machines and ventilators in the roof. The atmosphere is kept moist by use of wet sand, and the eggs are damped at each time of turning, which is carried out twice a day. One very interesting observation is that low fertility and high vitality are usually associated.

The methods of rearing are such as I have not seen elsewhere. Along one side of the incubator-room is a broad bench, upon which are placed L-shaped boards which fit together, forming sections about 30 inches long by 12 inches wide and 11 inches deep. When dried off in the incubators, the young ducklings are placed in these, about fifty to each compartment, where they remain for seven days. No heat is applied, but the room is always maintained at a comfortable temperature by the incubator lamps. The bench is covered with peat-moss litter and cleaned regularly. For feeding the section boards are removed.

When the birds are a week old they are transferred outside, and placed in rough boxes or packing-cases laid upon their sides (Fig. 56). Four of these are used, grouped with the open tops to form an uncovered square in the centre, from which the ducklings cannot escape except by going into the cases. As these packing-cases are bought very cheaply, the cost of equipment is small. No heat is applied, and the object is to harden them off without undue exposure. From whichever quarter wind may blow they are perfectly sheltered. Here they remain for seven days more, when transference again takes place to open runs, formed by putting down 2-foot wire netting. In these runs large packing-cases are used as houses, two or three in accordance with the size of the birds. Here they remain until ready for killing—that is, about six or seven weeks. Lamps, suspended on poles, are kept burning in the runs all night, as it is found the birds are much quieter than if entirely in the dark.

The features of this plant, so far as rearing is concerned, are its simplicity, its low cost for equipment, and mobility. The danger of tainted runs by use of fixed houses is entirely avoided.

Belgian Systems.—Natural conditions in several provinces of Belgium are responsible for the wide distribution of ducks, though there are sections not so favourable as are others. Well-watered plains and valleys offer excellent facilities for duck-

FIG. 56.—REARING BOXES FOR DUCKLINGS.

breeding, and the great rivers, with their contributory streams, afford favourable opportunities in this direction. In two districts dealt with below the industry is large and highly specialized. Throughout the country ducks are kept by a great number of farmers, few in number, it is true, but large in the aggregate. There is a very general idea that ducks help to keep the land sweet. Upon what that opinion is based I do not know, but it is undoubtedly true that duck manure is very valuable and fosters the growth of the finer grasses. Evidence of such result has been found in our own land. Around Ghent large numbers of ducks are to be seen, though that is not one of the places referred to. Throughout Flanders and Hainault ducks are to be found everywhere, and the same can be said as to other districts generally. The demand for these birds is very large, as also for their eggs, which are thought to have the flavour of those of wild birds, and are specially valuable for cooking purposes. The system adopted, with one exception, has been followed for centuries, varying considerably from those met with in England.

FIG. 57.—DUCK HOUSES AT LANDSMEER.

Huttegem and District.—One of the most important centres for this industry is in the valley of the Escaut, near the city of Audenarde, in East Flanders. On both sides of the river above Audenarde the valley is flat and broad, flanked by hills of a fair elevation, consisting of water-meadows, which are flooded in the autumn, remaining under water until the end of February, when they are drained. These meadows, which extend several miles from the city named, beyond the village of Huttegem, are communal property, and upon these ducklings are raised in large numbers. Here they find an abundance of rich natural food, and in return greatly improve the land by their manure. It is no uncommon sight during March and April to see a hundred thousand ducklings on the meadows. In April the birds are removed and the land left for hay. When that crop is cut the meadows are used for cattle and chickens. When flooded, the valley is one vast lake, nearly two miles in width. The road and dwellings by Bevere, and on to Huttegem, are just above the water-line. It is in these dwellings where the duck-breeders live. Such is the scene of a remarkable industry. Cultivation of the fields other than the water-meadows is good; the houses, however, are primitive and not of a high order of comfort.

A Spartan Plan.—As a rule, breeding ducks are accommodated in one of the ordinary farm buildings, which are usually spacious, but cannot be said to conform to our ideas of light, ventilation. or cleanliness. The ducks wander all over the meadows in search of food, but are not allowed out until after they have laid. They return in the evening to their own quarters, when they are shut up for the night. Hens are almost entirely used for hatching, and a local breed called the Huttegem is kept for the purpose. This is a large-bodied fowl, coming into lay very early, and, in fact, becoming broody after producing seven or eight eggs. The maternal instinct is so strong that the hens of this breed will sit for three months without a break, contentedly taking three nests of eggs in succession. When the ducklings are hatched, they are kept very warm for a couple of days, frequently in the dwelling-room, by the side of the fireplace, after which they are transferred to coops made of straw. These coops are placed in the farmyard for a few days, after which they are removed to the open. The reason for the use of straw is that the coop can be easily moved, and when it becomes dirty is burnt to destroy all parasitic life. At first the hens have cords tied to the legs staked in front of the coops. At a later stage they are put out on the meadows, where natural food is abundant.

Hardihood characterizes the Huttegem duck, necessitated by the method followed. Young birds for breeding are employed to secure early eggs, as hatching commences in August, so as to have ducklings ready for January, when sale commences. The season is a short one, ending in April, when the birds are removed from the meadows. It is " a stolen harvest." Rearing upon the Continent of Europe during the winter is more difficult than in the United Kingdom, as the weather is less favourable. Whatever it may be, the ducklings have to bear it; there is no coddling; if too weak they die. On one occasion I visited the Audenarde district early in February, when the watercourses were frozen and the ground covered with snow. Even under

PLATE XIV.

Straw Coop for Ducklings.

those conditions the ducklings were placed out in the open and allowed to go into the water, access to which was given by breaking the ice. The English plan has been to keep the young birds from swimming in water which is very cold, as that is thought to retard growth and induce cramp, but the Flemish peasants do not fear any such consequences.

Feeding the Ducklings.—Whilst worms and plants are chiefly depended upon, these are not enough to secure rapidity of growth, and food supplied is liberal. For the first three or four days a mixture of hard-boiled eggs, chopped fine, buckwheat-meal, and Indian meal, and made into a paste, is fed upon sacks, together with worms, after which two or three feeds a day are given of either steeped buckwheat or of buckwheat-meal mixed with maizemeal, the birds getting what natural food they can on the meadows. On this diet they grow well and rapidly, but, as already stated, do not make the size attained by our Aylesburys in the same time. There is no fattening in this section of Flanders. When the ducklings are about six weeks old they are sold to the professional duck feeders at Lebbeke and Merchtem, who finish the work. One point to be noted, however, is that the water-meadows are communal land, and that the flooding and draining are regulated by local authorities, the peasants having feeding rights thereon. It is stated that nearly 200,000 ducklings are raised annually in the district, but that they are decreasing somewhat.

Laplaigne.—The other section of Belgium where duck-raising is carried out on industrial lines is at Laplaigne, in the province of Hainault, on the French border, and, like Audenarde, on the Escaut River. Here is a great plain, on one side of which is Fontenoy, famous as the scene of an important battle in 1745 when the English and their allies were defeated by the Frenc under Marshal Saxe. It is low-lying land, divided by water-courses, and in some cases below the level of the river. A considerable portion consists of water-meadows, as at Huttegem, under communal control, and flooded every year. Here is bred a small duck of somewhat uncertain type, but very rapid in growth, producing fine and abundant flesh, which is greatly in demand at Brussels, Lille, etc. Upwards of 100,000 are produced annually in the commune of Laplaigne, which can be fully credited, for ducklings seem to be everywhere, both in large and small flocks. One breeder raises annually about 10,000 birds. A distinctive difference between the Huttegem and Laplaigne ducklings is that the latter are reared practically all the year round. The birds are ready for killing in seven weeks, by which time they weigh 3 to $3\frac{1}{2}$ pounds.

Methods at Laplaigne.—In many respects the system adopted resembles that already described in connection with Huttegem, and it is, therefore, not necessary to describe it in detail. But there are differences of importance. In the first place, incubators are here employed almost entirely, made necessary by the fact that the ordinary fowls of the district are Black Braekels, which would be useless as sitters, equally because they are small in size of body and unreliable. The results are said to be very satisfactory, and the introduction of these appliances has led to a great extension of the industry. A second difference is that during the first fortnight the hen and her brood are enclosed during the day within hurdles, which are placed by the side of, and cross, the watercourses, where they have access to the small stream, on the banks of which a large amount of natural food is obtained. After that period they are given full liberty. The same system is adopted of helping them to find worms, as already mentioned. Another method is that no artificial heat is provided for the ducklings, but they are very fond of sleeping during the day on beds of fresh stable manure placed in convenient positions, whence they obtain a considerable amount of natural warmth. Sheds made with hurdles and straw are distributed, into which the ducklings can go when disposed to obtain shelter, and the older ducklings are permitted to wander among the trees, which are found in clumps here and there.

Feeding and Fattening.—As distinct from what has already been stated as to Audenarde, the work is completed at Laplaigne by fattening and killing the ducklings. The method of feeding generally followed is that the food supplied consists of crushed wheat or buckwheat-meal, and mixed with cooked potatoes, to which a little meat-meal is added. This mixture is prepared with water into a paste. Probably the reason why meat-meal is added arises from the acknowledged fact that, as a consequence of the large number of ducklings bred and kept on the meadows practically all the year round, worms are becoming scarce, as might be expected, for the land does not appear to be so rich as at Huttegem. What effect a continued deficiency of worms will have, and how far it will increase the cost of production, remains to be seen. That meat will form a good substitute cannot be doubted. The food named above is continued all the time, except that during the last two weeks, when the birds are being fed off, steeped buckwheat forms part of the diet, as that is found

PLATE XV.

Enclosure for Young Ducks at Laplaigne.

to give firmness to the flesh. When this stage is reached the ducklings are kept in open-fronted sheds with outer yards, so that they do not obtain much exercise, and as a consequence increase rapidly in weight.

American Duck Farms.—In America the methods adopted have been on totally different lines, in that production has mainly been on great plants, many of which have been very successful. A considerable number of these duck farms are to be found in the States of New York, especially on Long Island, Massachusetts, New Jersey, and Pennsylvania. It is estimated that from the section of Massachusetts around South Easton and Wrentham half a million ducklings are marketed annually. Other differences between European and American methods are—(1) That in the latter the buildings are substantial and have fixed yards. That is a saving in labour, and probably in cost of equipment, but involves risks of tainted soil. In fact, one large duck breeder said to me that if he were commencing again he would have movable houses, as there was a steadily increasing tendency after some years to loss of virility. (2) That as a general rule the breeding stock are kept upon these duck farms, which system, whilst possessing many advantages, yet in the absence of special precautions tends to degencracy, more especially where birds are reared and maintained within small enclosures. (3) That what is known as the "dry" system is adopted in many cases, by which is meant the breeders are not provided with their natural element—water—to swim in. (4) That artificial methods of hatching are used for breeding stock as well as those birds which are to be killed.

Duck Houses.—Upon one plant—that of Mr. James Rankin, at South Easton, Massachusetts—the houses for breeding ducks are 216 feet long by 20 feet deep. Each compartment is 20 feet by 10 feet, and accommodates twenty-five birds, four drakes to twenty-one ducks. The yards in front are 100 feet long by 10 feet wide. These runs provide no water for swimming, and the ground is swept over every week, whilst in the autumn, when the breeding season is over, they are planted with rye grass to sweeten. The breeding house on the farm of Weber Brothers, at Wrentham, Massachusetts, is 260 feet by 20 feet, and similarly arranged. In each case the divisions are low removable boards which can be easily stepped over. On both plants several long houses are provided for the growing stock. Many of these are heated on the pipe system, and the others are used when the birds no longer require artificial heat. It is significant, however, to find that the Weber Brothers believe that better results would be obtained if the breeding stock had water in which to swim, which they are endeavouring to secure; and also, at the time of my visit, that, in spite of all their efforts to sweeten the land by planting, it was showing signs of becoming tainted.

Feeding and Killing.—The food given varies considerably from what is used in England. On one plant, from the first, the food consists of four parts wheat bran, one part Indian meal, with enough of low-grade flour to make the mass crumbly but not pasty; and, for the first feed, about 5 per cent. of sharp grit, but after that 2 per cent. is regarded as sufficient. As the birds grow older the size of the grit is increased. After the third day about 5 per cent. of fine beef scrap is added, soaking it a little before mixing, and when about a week old green rye is given if available, or finely chopped cabbage or lettuce. When stale baker's bread can be obtained, it is used instead of the bran. As the birds reach a fortnight old more Indian meal is added, making the proportions three parts bran to one part of the Indian meal, and when the birds are fattening the mixture consists of two parts of Indian meal, one part of wheat bran, one part of low-grade flour, 10 per cent. of beef scrap, 10 per cent. of green food, and 3 per cent. of grit, proportions by measure.

Feeding and Fattening in Bucks.—Reverting to English methods, it will be realized that a most important part of the work is the feeding and fattening of the ducklings. In the Aylesbury district feeding varies considerably in accordance with individual ideas, and also with what food is available. Many breeders use hard-boiled eggs chopped fine and mixed with boiled rice, though some give toast soaked in water. After three days to a week of this feeding, the birds are put upon Burmah rice (carefully simmered) and toppings (which is the local name for fine sharps or middlings), or upon barley-meal and toppings, a variety being given in order to stimulate the appetite. The manner of treatment described is continued until the ducklings are five weeks old, by which time they should have grown to a large size. Now a different plan must be adopted, for the frame thus built up must be covered with the flesh, and feeding should be to that end. The ducklings are divided into flocks of about twenty each, as near as may be alike in age and size. The best manner is to feed the birds from long wooden or metal troughs, of which there should be a sufficient number to allow every duck to find a place. The quantity of food can only be gauged by the appetites of the ducklings, and the attendant

PLATE XVI.

Duck-Fattening Houses and Pens.

will soon find out how much is necessary without allowing any waste. It is a great deal better to be rather short than permit them to overeat. No water must be supplied until they have eaten, and then only in small quantities; and they should not be allowed to swim until a day or so before they are to be killed, when a bath will clean their plumage.

In the Aylesbury district the food supplied during the final three weeks is of a fattening nature, and large quantities of greaves or scrap-cake are used for this purpose. Whilst there should be variety in the food, so as to tempt the appetite, it is believed that rice properly prepared is the finest of all for this purpose, as it is cooling to the blood, stimulates the appetite, lays on flesh, and is easy of digestion. The best rice for feeding is the coarse kind with its husks, called in some places "paddy" rice. It can often be purchased at 8s. to 10s. per hundredweight or less, and at that price is a cheap food for fattening. The method of preparation is important, as it must never be given uncooked, and can easily be spoiled in the preparation. If the proportion of 1 quart of rice be taken, 3 quarts of water should be added, and 1 pound of broken greaves, with a little seasoning powder. The whole should then be placed in a vessel, and allowed to simmer (not boil) until the rice has swollen and absorbed all the water, which it will do in two or three hours. The rice should then be broken up, and given to the birds when it has cooled down somewhat. For variation, Indian meal mixed with thirds or pollard may be used. In that case the greaves or meat-scraps should be boiled, and then, with its liquor, mixed in the meal, all making a crumbly, friable mass. Too often the importance of green food during the process of fattening is forgotten, but a supply of such as may be available should be given every day. Nettles, boiled and mixed with the food, are largely used. Fresh lettuces are also good, but they are not to be obtained at some periods of the year, and then cabbage should be substituted. Green food is cooling to the blood, and tends to keep the birds healthy. Another most important matter is that of supplying grit, for without it the ducklings will be unable to digest their food properly. The quantity they will consume is proof of its value, and a boxful should always be within their reach.

Ducklings undergoing the process of fattening should not be allowed to swim in water, but, as we have already said, they must have water to drink. A further point to be observed is that ducklings during the fattening stage should not be disturbed or frightened, and even the presence of strangers will retard growth. It must be remembered, however, that the system here described is only suitable for birds intended to be killed at an early age. Where breeding stock is to be raised, the system adopted should not tend to force growth, as this would do harm, and the food supplied should be throughout the whole period similar to that given during the early stages, and after the first two or three weeks—except the weather is very cold—it is better to allow the ducklings access to water, so that they may swim. It will be found that they will be longer in reaching maturity, but their vigour of body will be very much greater.

Killing.—Ducklings should be starved for twenty-four hours, and are killed by breaking the neck, as in the case of chickens. A barrel should be provided with slots cut in the top, in which one leg is placed, to allow the bird to hang head downwards for two or three minutes, so that the blood may drain well from the body. Then they are plucked completely, except upon the wings and head and 2 inches down the neck. The wings are turned, and the birds laid breasts upwards upon a flat board about 15 inches wide, the heads hanging over the side. As soon as half a dozen are ready, another board is laid on top and heavily weighted. They should be allowed to thoroughly cool, and are packed in baskets holding a dozen, and each lot should be even. Packing ducks whilst warm is a fatal mistake, often causing them to reach the market in a green state.

Cost of Raising Ducklings.—The cost of feeding ducklings, as we have already mentioned, is an important item, and hence the importance of early maturity and of marketing during the duckling stage, for profit depends upon whether that is accomplished. Taking into account cost of egg, of incubation, and of feeding, a duckling at nine weeks cannot be produced under 1s. 6d. to 2s. if the labour is undertaken by the breeder, and to do so requires economy in feeding and management. Where labour has to be paid for, and interest paid on equipment of plant, 4d. to 6d. more must be added, even where the operations are upon an extensive scale. On this scale a duck at fifteen weeks will have cost 1s. beyond the sum named, and will be of less value than it was as a duckling. Of course, where less intensive methods are adopted the expense can be minimized; but the returns will be reduced to an equal extent. The plan we have described will only be profitable for the production of ducklings early in the season, leaving a large margin under proper management, where the conditions are favourable and the markets satisfactory. Feathers enter largely into the question of profit, but these are dealt with in a later chapter.

CHAPTER XIX

GOOSE FARMING

The branch of poultry husbandry which has alone declined during recent years is that of goose-breeding. In all others great advances have been made. What is here stated is not restricted to any one country, but is almost universal—at any rate, wherever progressive farm conditions prevail, even to a lesser extent. The reasons for the decline referred to are given below. So far as the United Kingdom is concerned, the following figures, which are all we have available, show the comparative statistics relating to the goose for 1885 and 1908 in Great Britain, and for 1885 and 1912 in Ireland.

	1885.	1908.
England	615,724	494,000
Wales	234,146	192,000
Scotland	35,440	26,000
Ireland (1885, 1912) ..	2,133,609	1,731,934
Totals	3,018,919	2,443,934

These are inclusive of old and young birds, and do not, therefore, represent the breeding stock. It will be seen, therefore, that the reductions in Britain are as follows: England, 19·67 per cent.; Wales, 18 per cent.; Scotland, 26·63 per cent.; Ireland, 12·69 per cent. The same tendency is evident in other lands, even in Germany, where the eating of goose flesh in greater than in any other country.

Reasons for Decline.—Save in those countries where the land is mainly open and largely rough pasture, fewer geese are kept than was formerly the case. During my observations throughout Germany, almost everywhere that fact was recorded. The supply is chiefly Russian, from seven to nine million live geese being imported annually. As cultivation increases, geese decline. Such was true in France, in Denmark, and in Northern Italy, as it has been in Great Britain and Ireland. With enclosures the profitable growing of these birds is lessened. In days gone by they were bred and reared on common lands, where they found the major part of their food at no cost to the owners. That there was great benefit thus derived cannot be doubted. Unfortunately, over large areas, as has been succinctly expressed, the common was stolen from the goose, which is more serious in its ultimate effect than stealing the goose from the common. That, however, is not all. Wherever cultivation has advanced, farmers have found that they could turn their fields to more profitable advantage, and avoid the damage they feared to crops and pastures. With the decline of arable land and laying down so much of the country to grass, many of those who had been accustomed to buy annually a flock of goslings for putting on the stubbles have ceased to do so, which explains why the imports of lean live geese from Ireland and the Continent of Europe have decreased to so large an extent. At one time that was a huge trade, but it has shrunk greatly. It must be admitted that farmers know their business well, for, in view of lower returns, the contraction of opportunity means that what might at one time leave a moderate margin of profit no longer does so. The result is indicated in the poultry census of 1908, wherein it is shown that on the farms of Great Britain there were only eight adult geese per thousand acres of cultivated land. Although Ireland has nearly twice as many of these birds as in the whole of Britain, due to its greater extent of open lands, the same tendency is to be noted. The total number of geese bred annually in the United Kingdom is about 1,700,000, or slightly over one-fifth of a goose per family of five persons per annum. That is indeed a poor result.

Reduction in Demand.—What has here been stated would probably not have taken place to nearly the same extent had the decline in supplies, as is generally the case, been accompanied by a corresponding increase of values. Such has not, however, been found, otherwise we might have sought an explanation in the influence of higher prices. In multitudes of households a goose is never found upon the table from one year end to another, the reasons for which are worthy of study. Formerly there was a great demand for geese at the Christmas season. That was the treat of the domestic festival. Goose clubs enabled even those with modest means to indulge to this extent, and the sale through their media was very large indeed. If no bird of this class was purchased at any other time, then it made an appearance. Such is no longer true to the same degree, so far as our own country is concerned, although in the last year or two an increased sale and better prices have been noted. The demand is for other classes of meat. The change in taste is by no means restricted, however, to this instance. It is not merely a question of fashion.

Size of Geese.—Throughout Southern Europe the type of goose generally met with is smaller in size of body than those found in the western and northern countries of the Continent. These are, in my judgment, descended from the Roman goose, still to be found in Italy. During visits to the last-named country, as to Southern Germany and Austria-Hungary, I realized that this was the common type. Plump, fleshy specimens, weighing in the late summer 8 to 9 pounds, are to be seen on the markets, and appear to meet with a steady demand. These birds come within the purchasing power of a large number of householders, which would not be the case with larger specimens. As is well known, such foreign geese as are imported into Britain are smaller than native supplies, or even those from France. Poulterers report that within recent years the demand on our markets has been for birds of a more moderate size. The question is, therefore, whether by the introduction of smaller races than the Embden and Toulouse, such as the Roman, we could not rehabilitate the goose in popular favour, provided, of course, that these were fleshy in relation to the total weight.

Selling Geese.—Were what has just been suggested carried out, and geese of a size more in keeping with the requirements of ordinary householders offered for sale, there is every probability that we should find a much larger demand from Michaelmas onwards. There is also another development which I should like to see tried—namely, the selling of parts of a goose. That plan is common in many Continental countries, more especially where larger geese are common, as in France and Northern Germany. In the latter this system is carried out most completely. Every part of the goose appears to be utilized. Even the skin is cooked in cheap restaurants, and is said to make a highly appreciated dish among the poorer sections of the community.

Places for Geese.—The best places for keeping and breeding geese are on the borders of commons, moors, or waste lands. There is an abundance of areas in all parts of the country where flocks might be kept, thus utilizing ground of no value at present, and, by providing profitable labour for farmers and cottagers, add to their incomes. All that is needed for food, except when fattening, will be a little corn or meal at night, as they will forage for the rest. It is better if the number kept is sufficient to let a boy drive them to their feeding-ground and tend them during the day. They should be under cover at night in a comfortable house, and with good straw bedding. A pond or stream is by no means imperatively needed, but when it can be given is conducive to their well-being. It is an interesting fact that in many respects geese are very similar to sheep, and whatever land is suitable for one is equally favourable for the other. The writer can remember how at one period many labourers reared a small flock of geese upon the commons, and where these still remain that custom is followed. It may be accepted as a recognized fact that it is much better for the work to be divided

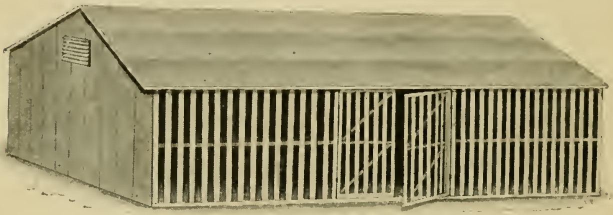


Fig. 58.—House for Geese.

between rearing and feeding; land which is suitable for the former is frequently not calculated to give the best results in the final stages.

Housing Geese.—The goose is a hardy bird, but at the same time requires protection during unfavourable seasons of the year. Fig. 58 shows the design of a very useful form of house, which is equally suitable for geese as for turkeys, where a special building must be provided. In the majority of places, however, some vacant farm building can be used in this way. The house should be large enough to allow 10 square feet of floor for every bird; and whilst there should be perfect shelter overhead, it is better to either partially or entirely bar the front of the house, so that the birds may have plenty of fresh air. The building should be lofty and well ventilated, and we prefer erections which are at least 7 feet 6 inches in height. It must be thoroughly dry, and a great amount of loss will be avoided if care is taken in this direction. Although geese are water-fowl, the same remarks apply as in the case of ducks, and it is better if the floor is elevated a little above the level of the outside ground, so that there may be no danger whatever of dampness. An excellent plan is to litter out the house well with straw or dried leaves, either of which forms a very valuable manure when impregnated with the droppings from the birds, which must be driven in at night. If their food is given in the evening, there will be no difficulty in securing their return home.

Hatching.—Young geese commence laying about the middle or end of February, and older birds a month later. It is much better to breed from the more mature birds; yet if early goslings are required, the latter cannot be waited for, as they are considerably later in commencing to lay. When the strain is a good one—strong, and not at all inbred—then the eggs from young birds can be taken without fear, and will hatch out well, the only drawback being that they do not grow quite so fast as those from older stock. In no case should they be kept for breeding. In the case of white geese, if the eggs are left in the nest, as soon as about fifteen are laid the mother will show a desire to sit; but if they are removed regularly, she will probably lay nearly twice as many before desiring to do so. The latter is the plan usually adopted, and half the eggs are generally set under large ordinary hens, giving four to each. Some breeders never allow a goose to sit at all, considering that they are unsafe, being heavy and clumsy. If this plan is adopted, the eggs must be regularly sprinkled in the nest, as the shells are very hard and thick, or otherwise the young birds will not be able to break through. Some geese lay two clutches of eggs in one season, but they have to be early bred and from a good strain to do so.

The time of incubation for geese is thirty days, and it is better not to disturb the nest during the time, except in case of accident, as the mother is very spiteful and pugilistic. Should her mate be near, it may even be dangerous to do so, as they have great power in their wings, and can deal a tremendous blow. A regular attendant, however, soon becomes familiar to them, and he need not be so careful.

Rearing.—As soon as hatching is over, plenty of food and water should be placed near the goose, so that she may satisfy her own appetite, and then both her mate and herself will attend to the little goslings. Goslings are about the easiest of all domestic poultry to rear, and when once hatched require very little looking after. They are unlike chickens in that they do not require brooding to the same extent. When hatched, place them in a roomy coop or crate, 30 inches square, but it is better not to give a large run at first. The coop must be situated in a sheltered position, as the sun's rays are fatal to young goslings. If there are plenty of bushes or trees about, that is simple, for the coop can be placed under their lee; but if the situation is open and bare, some shelter must be improvised. The coop can then be made with a large eaved roof. In addition, hurdles, in which has been interlaced furze, should be provided, and if freely scattered about these will be welcomed by the goslings. An excellent plan is to cover the coop with furze, as that keeps it cool. In all cases the coop should be bottomless, for the goslings are unable to hold their feet on a wooden floor, and are very apt to injure themselves by slipping about. Goslings are not usually hatched until the weather is open and mild, and are not delicate by nature; but the coop should be made roomy, as the youngsters grow very fast. When about ten days old they can be liberated from the run, and will prove splendid foragers. At this period they may be removed to a house or shed.

Feeding Goslings.—Early feeding must be all in the direction of building up a frame on which the flesh may be laid. The best food from the first is barley-meal and wheat. The whole grain should be scalded and dried up with meal. Variations may be made by giving ground oats, or by boiling potatoes and drying them up with the meal. When about two months old the birds may be fed on raw grain and sliced potatoes. Such feeding, however, is expensive for ordinary purposes; that is why maize is generally used. Goslings are also very fond of young grass, green onions, chickweed, and an early cabbage hung within their reach will be highly appreciated. No other special provision is necessary except the giving of water, which must not be forgotten.

Young goslings, if the fields are clear of their crops, should be allowed to wander about most of the day when the weather is at all fine, but they ought to be placed under the care of a lad, so as to prevent their wandering away too far and overrunning themselves. He can easily keep them in order and bring them home at night.

For reasons which have already been explained, economy in feeding is most important in connection with goslings, and every ounce of unnecessary food given is to a large extent wasted. In many districts, especially on the richer soils and during a fairly moist summer, with the exception of a little food—say any good meal made into a paste in the morning, and a few oats or wheat steeped in water in the evening—they will not require any supplied food at all. They are essentially grass-eaters, and

PLATE XVII.

Goose-Fattening Sheds, Winsen-am-Luhe, Hanover.

will find practically the whole of their sustenance. The goose raiser should bear in mind that his business is not to substitute artificial for natural food, but to give the former in order to make up for any deficiency of the latter. During a very dry summer the birds will require to be fed constantly, because at that season there is no natural food available, and consequently they must be provided with an abundance, more especially of green food.

Fattening.—Geese are altogether different from ordinary fowls, or even ducks, in one respect, and a mistake is sometimes made in the final fattening off by putting each bird into a separate compartment. Geese never thrive in this way, and, instead of getting fatter, actually pine away. They appear to be miserable without company, and each lot should be killed together, or the ones left behind rapidly lose flesh. Some birds fatten quicker than others, and as they are seen to get into ripe condition, which can best be decided by the state of their appetites, they had better be killed off. As soon as they are as fat as they will be, the desire for food begins to slacken, and then it is that they should be despatched, or they will lose flesh instead of gaining it. The food should be soft in the morning, and corn in the afternoon, a large trough of clean water being always at hand, but not so that they can get into it. The soft food may consist of barley-meal mixed with Indian meal and pollard, and the corn of wheat and barley, which are better if steeped. Plenty of grit must always be provided.

German Methods.—In Germany consumption of goose flesh is enormous, and is almost universal, varying from the goose breasts of Pomerania to the *paté de foies gras* of Strassburg. Although there has been an advance in production in a few provinces, that is small as compared with the demand, owing to the rapidly increasing population and greater purchasing power. As a result vast quantities of live geese are imported, chiefly from Russia. In the vicinity of nearly all the great cities are huge fattening establishments, several of which I have visited. These are supplied by goose trains, consisting of special three-decked vans, some of which I have seen on arrival. One of these at Berlin had brought 15,000 geese from the Russian frontier. The system adopted is fully described in my " Report on the Poultry Industry in Germany."

The goose-fattening plants are in many cases on an extensive scale, splendidly equipped with large roomy sheds, plucking, chilling, and packing rooms. At one of those visited there was accommodation for 10,000 geese. The food given varies in accordance with markets. For lower-quality birds maize is largely used, as it is a cheap food and makes for bulk, even though that consists of oily fat, and therefore is not economical to the buyer. For the better-class trade oats and what is called crusted barley are used, producing abundant and firm flesh. Smaller specimens are fed three weeks, in which time they will increase in weight by $4\frac{1}{4}$ to $5\frac{1}{2}$ pounds. Larger specimens are fed four weeks, growing by $6\frac{3}{4}$ to nearly 9 pounds. If the feathers are plucked, they can be fed for six weeks, and exceptional specimens have been known to add 13 to nearly $15\frac{1}{2}$ pounds to the weight. All are dry-picked, as scalding spoils the fat.

CHAPTER XX

TURKEYS AS FARM STOCK

Nearly four hundred years ago the turkey was first introduced into this country. It speedily became a favourite dish with the wealthier members of society, continuing as a luxury until the latter half of last century, when it came into more general consumption. The demand is now general among all classes of the community, and would advance more rapidly but for the fact that inadequate supplies maintain prices to a high point, usually beyond the reach of our industrial population, who, however, are provided for to some extent by imports, which sell at much lower rates than do the best qualities of home turkeys and of French. As a rule, South European birds are lacking in flavour and dry in flesh. They are, however, much cheaper than our own.

More Turkeys wanted.—A reasonable estimate is that about two million turkeys are annually consumed in the United Kingdom, of which rather less than 25 per cent. are foreign. The finest imported come from France, almost rivalling our own, as the French are skilful breeders and feeders. In spite of growing demand, there has not been any marked increase of production within recent years, which is surprising in view of the fact that under suitable conditions and with proper management there is no more profitable branch of live-stock, provided the occupations are large. This is essentially a farmer's fowl, demanding a considerable amount of space to roam over. The recorded number of turkeys in the United Kingdom is as follows:

	Adults.	Young Turkeys.
England (1908)	146,000	395,000
Wales (1908)	26,000	61,000
Scotland (1908)	27,000	42,000
Ireland (1913)	70,428	963,046
Totals	569,428	1,461,046

It is evident production could be doubled without danger of outreaching demand. Presuming that the above figures are correct, the relative number of young birds to adults is remarkably small. Respectively these are—

In England	2·7 young to	1 old bird.		
In Wales	2·34	,,	,,	,,
In Scotland	1·55	,,	,,	,,
In Ireland	5·65	,,	,,	,,

Such can in no case be profitable. The average ought to be at least eight to ten young turkeys to each adult. At the present time the total consumption does not appear to be more than one turkey annually to every twenty-three inhabitants in the United Kingdom.

Space required.—Within the last few years serious losses have followed the adoption of more intensive methods in turkey-breeding, especially in America, where the effects have been most disastrous, devastating what at one time were great turkey-producing districts in New England. During my visit to some of the chief centres, I could come to no other conclusion than that this result was owing to tainted soil, following the keeping of birds beyond its capacity—that is, by concentration rather than distribution. On farms visited it was revealed that, even where there was plenty of land for the numbers maintained and bred, these have been kept and reared near to the homesteads, with the result that the soil was "turkey-sick," and various diseases, principally what is known as "black-head," carry off the young birds. We have not been without examples of the same nature in this country, though less serious and in isolated instances, which ought to be a warning.

Again, it is desirable to emphasize that the turkey is more suited to those who occupy larger or medium-sized farms than upon small holdings. There can be no question that under suitable conditions, where plenty of space is available, there is no branch of farming which can be made to yield a greater amount of profit. The number of turkeys must in every sense be relative to the amount of land available, and that land must be cultivated in a regular manner to its fullest extent. There is no reason whatever why in many parts of the country turkey-raising should not be increased enormously.

Suitable Conditions.—A very common impression is that turkeys are delicate. There can be no question whatever that during certain stages of their growth they require careful attention. A word is said below with regard to this delicacy. My point is to recognize that under many conditions the turkey would be found delicate by reason of the unfavourable nature of the soil. These birds can withstand cold, and even rain does not affect them so adversely as many people imagine, because it is well known that there are vast quantities of turkeys raised in Ireland and in some of the western districts of England. The question which anyone who is taking up turkey-farming must consider is the nature of the soil. Damp and heavy lands are fatal to success, and neither breeding stock nor the young birds will thrive or prove profitable under such conditions. As I have explained in the chapter dealing with climate and soil, heavy land is colder by reason of the large amount of moisture contained therein, which checks the growth of young and adversely affects the older birds. Moreover, even if the turkeys are grown to a killing age, their flesh will never be so good as if they had been raised upon a more kindly soil. I do not advocate for one moment that they should be kept upon sand, for the nature of sandy soil is by no means favourable to the extent frequently imagined. The better the land, provided that it is light or medium in its nature and well drained, the better the turkeys will be, and the less trouble will they cause to the owner. The conditions which are most suited to this industry are where the land is hilly or undulating. There the natural drainage is generally good. It is undesirable to attempt rearing the birds in low valley lands, as these are generally damp. Any farmer, therefore, who is contemplating extending his enterprise, and raising considerable numbers of turkeys, should in the first place consider the nature of his soil. If it comes within the category mentioned, even though the elevation should be considerable, there are no objectionable external reasons relative to the position. Flat land, it is obvious, is not nearly so good, as it is seldom well drained, although large numbers of turkeys are raised in the neighbourhood of the Fens. A further point to consider is that wherever turkeys are bred there must be plenty of natural shelter. Hence we should be inclined to shut out considerable areas of country which are practically treeless, and where, consequently, the birds would be unduly exposed.

Within the last few years several attempts have been made in this country, although the same plan was carried out even as far back as three hundred years ago, to breed turkeys under more natural conditions than upon ordinary farms. The stock are placed in woods, and allowed to live there in the way which would be the case in their wild state. No interference takes place with them; they breed when and where they like, and as soon as the number increases beyond a certain stage, or when any birds are wanted, they are shot. This system deserves encouragement, because it should be the means of providing those who raise turkeys for market with vigorous stock birds, and in this manner correct the tendency, which is always evident under domestication, to enfeeblement. To claim, however, that this is the only way in which turkeys should be bred is to absolutely ignore the fact that the industry is not intended merely for the purpose of providing either sport or pleasure for a few wealthy folk, but as a source of income for our agricultural community. If turkey-raising were to be restricted to the conditions we have named, for every hundred who now raise these birds there would be only one who could possibly do so.

Stock Birds.—The male turkey to a larger extent than is generally assumed influences his progeny. That is true if he were mated with only one hen; but when he will serve a dozen or a score of females, and be the progenitor of all their poults for that season, it is at once evident that his direct influence will be twelve or twenty times that of each individual hen in the flock. Any deficiency in one hen will apply to her brood and no more, whereas inferiority in the male will influence those bred from all the hens. To put it on a weight basis, if, by lack of size or weakened constitution, the poults of one turkey hen when matured are 1 pound each below the average, the owner may lose returns for, say, 12 pounds; but if the cock is the cause, all will be affected, and with ten hens 120 pounds may be sacrificed. Further, lowered vitality in one hen may mean infertility in her eggs or death of the youngsters; but should the cock bird be at fault, then the loss will be commensurately greater. Whilst, therefore, it is desirable to make careful selection of the hens, as shown below, and any neglect in that respect is to be deprecated as false economy, the choice of the male is of tenfold greater importance, by reason of the wider influence exerted by him.

In selecting a male turkey, he should be well developed in breast and body, without excessive size, have a strong, long frame and limbs, be active in habit, carry himself in a stately manner and freely disport his plumage, be ready to resent the presence of strangers, and be quick and strong in voice. If in addition to these he owns a satisfactory parentage, he can hardly fail to give satisfaction. A further point is that he should have been reared under favourable conditions, where there was plenty of scope for his wandering spirit.

There is a greater difference in weight between the male and female turkey than is the case with other kinds of poultry. That appears to be true equally with the wild and domesticated species. As will be seen by the following table, taking 100 as the mean for the male, the figures shown indicate the relative weights of the females:

Breed.	Male.	Female.
Dorking fowl	100	79
Minorca fowl	100	86
Plymouth Rock fowl	100	82
Aylesbury duck	100	90
Toulouse goose	100	72
Bronze American turkey ..	100	55

So that in standard-bred birds the female turkey is only a little more than half the weight of the male. At the same time, her influence in respect to the size which poults bred from her will ultimately attain is considerable, and consequently it is desirable that she should not be small. She should be fully developed in length and depth of body, be active in habit, yet quiet in disposition, and amenable to control. A turkey hen which makes a good forager is more likely to produce vigorous poults than if she is an indolent "stay at home." Apart from structure and size of body of the individual, it may be expected that the daughter of a good mother will reproduce the maternal instinct satisfactorily. The turkey hen is dignified rather than assertive in carriage, and has a soft, flute-like voice. As her plumage is less brilliant than that of the male in the colour breeds, so long as she conforms to the racial characteristics, it is unwise to accord any great weight in that direction.

Age of Breeding Stock.—The consensus of experience is that the domesticated turkey is much less vigorous than the wild species, specially indicated by difficulties in rearing, which are thought to be greater than in almost any other class of poultry. The explanation may partly be from the fact that such domestication has been comparatively recent, and that these birds have not fully adapted themselves to the changed conditions, though after four centuries that should not be the case. I have no doubt whatever that the most potent reason for weakness in the poults is due to the use of immature stock, a fact which is becoming recognized by breeders, though not nearly to the extent necessary. It is generally accepted that a turkey does not attain maturity until it is nearly three years old. That being so, from such age onwards should be the period when the birds will transmit to their progeny the greatest amount of constitutional vigour. On the other hand, if mated before maturity is attained, or, rather, before it is approaching, and such is continued in successive generations, gradually lessened powers are the result. Such is scientifically true and in accordance with practical experience.

The period of mating, however, should not be unduly delayed, otherwise functional activity may be checked and fertility lessened. A safe rule will be not to use yearlings of either sex as breeders, and to regard that as the period of growth. Matings should be made when two years old, and can be continued for three years. As there is no advantage in very early hatching of turkeys, the temptation to use young stock, as when breeding table chickens and ducklings, is absent. The one drawback to the use of older males is that they sometimes tear the hens, but that can be prevented by cutting the spurs. The disproportion, already referred to, in size of male and female turkeys makes it all the more necessary that the latter shall be as old as the former, and if either is the younger it should be the male.

Size of Domesticated Turkeys.—It is a very common opinion that the wild-turkey is much larger than any of our domesticated races, but fuller inquiry does not justify such a view, and it would be against all experience with other species.

In this connection there is a very important question for the breeder, namely, What weights should the stock be when mated? —that is, in relationship to the general standard. To a considerable extent size in our domesticated races is abnormal, and by neglect we should find reduction very speedily. Turkeys are kept entirely for their meat qualities, and therefore volume of flesh is of importance. We require bulk of frame, a deep keel, a long sternum, and stout legs, abundantly covered with strong, thick muscles, but we do not want fat, which adds to the bulk, and at the same time checks the functional and muscular activities. Therefore, both in the case of cocks and hens the body should be kept hard and firm, and, so long as the skeleton is large, heavy weights are undesirable, but more so in the former than the latter. Hens weighing 16 to 17 pounds, and cocks scaling at 20 to 22 pounds, will produce quicker-growing and ultimately heavier poults for the market than would fat specimens weighing several pounds more. The capacity to fatten must be there. That is frequently a family quality.

Apart from the use of yearlings for stock, sometimes we find turkey breeders who keep the small, weedy specimens, which can only be sold at reduced prices, for the next season's work. That is a foolish action, and needs no more to be said in condemnation. Others grow all in the same manner, and then pick out in December such as they wish to retain. Selection of those that are intended to be used as breeders eighteeen months later should be made in the early autumn before the fattening or feeding-off stage commences, and given a free run where they can find the greater part of their food until the supply is reduced.

Number of Hens to Male.—One impregnation will usually fertilize the entire batch of eggs laid by a turkey hen. Therefore, as the number produced by her is not large, a male can be used for a considerable flock. There are great variations in the number of eggs produced by individual hens. Record has been made of one bird laying eighty eggs in a single season, but that is very exceptional, and as a rule one-fourth to one-half that number would be more general. We have no definite data as to how many eggs would be fully fertilized, but probably a dozen to fifteen would be the maximum. Therefore, increased production would necessitate successive service. Turkeys are not, however, kept to produce eggs, except for hatching purposes, and there is nothing to be gained by increasing unduly the number laid. That this can be effected is unquestionable in the same way as with other poultry—namely, by removal of eggs from the nest as they are laid. In this manner many breeders obtain from twenty to thirty eggs before the hen commences to sit, the excess of which above her capacity to cover are given to yearling hens or ordinary fowls. In experience it is found that an active two-year-old male can be used with a score of hens, reducing the number in succeeding seasons until ten is his final year's harem. As a rule only one batch of eggs is produced each season, though sometimes a second lot will be obtained in the summer, which are not, however, usually worth using for hatching.

Houses and Roosts.—Not much need be said upon these points, for the reason that, in the case of houses, the less they are used the better. Turkeys should always be kept separate from other poultry and treated specially. He would be a poor farmer who housed his horses and pigs, his cattle and sheep, in one building. Where large trees are available for shelter, the better plan is to place roosts below them similar to those shown in Fig. 60, and let the birds live in the open all the time. Sometimes a large roomy shed or barn is available, which is useful for adult birds. The only disadvantage is that frequently care is not taken to secure sufficient ventilation, and that the birds do not during the day range to any great extent. Where a house has to be built, that shown in Fig 59, made of furze bushes, would be very valuable during the fattening stage. A house 40 feet by 15 feet,

Fig. 59.—Shed for Turkeys.

and 10 feet to the eaves, will accommodate forty turkeys—that is, allowing 15 square feet of floor space, or 150 cubic feet of air space, for every adult. The earth should be dry, and may be littered with chaff, in which grain may be fed to be scratched

Fig. 60.—Roost for Turkeys.

for. Perches made of tree branches, as seen in Fig. 60, can be placed at the back, 3 feet above the ground. The only excuse for using houses for turkeys is when foxes are troublesome, except in the month before the birds are killed.

Hatching.—One of the peculiarities of the turkey, due probably to her more recent domestication, is that she prefers to lay in a nest of her own choosing. Up to the present time artificial incubation has not been found successful in connection with turkeys, although one of the leading turkey breeders in Suffolk, Mr. Gage Harper, employs an incubator for use in the last two days, simply to bring the young chicks out. He does not recommend the eggs being kept in an incubator during the whole period. Turkeys make splendid sitters and mothers, and, as there is no advantage in too early hatching, the hens usually become broody quite soon enough for our purpose. Where the turkeys are roosting in the trees it is an excellent plan to put two or three boxes or empty barrels upon their sides in some out-of-the-way corner. Very often it will be found that the turkey hen, imagining that she has discovered a place of which no one else knows anything, will commence to lay there. At this period it is necessary to observe her very carefully, and to remove the eggs as they are laid, leaving a dummy in the nest. When she has produced about fifteen eggs some may be left there, and it will be seen that she will commence her sitting operations. If desired, she can be allowed to sit in the same place; but as many of the best breeders prefer to have the birds under control, when she has become thoroughly settled upon the nest, she may be removed at night elsewhere without much fear of breaking her off. That plan is certainly desirable, because otherwise the male is apt to disturb her and cause mischief to the eggs. Where turkeys are put upon nests of the kind last referred to, these should be in boxes at least 30 inches square, and be there treated in exactly the same manner as described previously for fowls. It is well to mention that sometimes a turkey hen can be induced to lay twenty to thirty eggs. Under these circumstances she may be provided with fifteen, and the remainder placed under a quiet, well-feathered, and good sitting ordinary hen. If that plan is adopted, when the hatching is completed the entire batch may be given to the turkey for rearing, as she is able to brood a much larger number of chicks than she can cover eggs. We must not forget that turkeys are very close sitters, and therefore it is essential to see that they come off the nest every day for feeding. A turkey hen, if allowed, would feed upon the nest, but that is neither good for herself nor for the embryos. If she is carefully handled, and removed to an open yard, and there given food, water, and a dust bath, she will return to her nest reinvigorated for another day's duties. The period of hatching is about twenty-eight days.

The advantage of using an incubator for the final stage is that there is no fear of the young chicks being crushed by the mother, as is often the case with such heavy birds.

Rearing.—When the young birds are hatched, they should be left in the nest for at least twenty-four hours before they are removed; but it is better that the hen should be well fed at once. Large roomy coops of the ordinary pattern are required for turkeys, and, for the first few days, to these should be added wooden-framed runs, about 1 foot deep, and covered with netting, because it is generally admitted that turkey chicks are slow in assuming full activity. These runs will not be required for more than about ten days, except when ordinary fowls are employed. Under such circumstances the hens must be confined for a longer period. At the end of ten days the turkey hens may be given their liberty, as they will not be likely to lead the chicks astray too far, in which direction a turkey is more reliable than a fowl. It is essential, however, that the hen and her brood shall be closed in at night. Coops should be placed where they will be sheltered from unfavourable winds, and be about 30 yards apart, preferably on arable land. These must be moved on to fresh ground every day. In districts where there is plenty of natural shelter that is all required in the way of protection. Mr. Gage Harper, who is one of the most successful rearers in East Anglia—a district which is wind-swept during the spring months of the year—follows a plan that can be recommended. He always plants a field in rye-grass, and as soon as the rye is from 24 to 30 inches in height lanes are cut with a mower in various directions through it, generally north-west to south-east. In these lanes the coops are placed, and, as a result, the young turkeys have all the benefit of fresh ground and of sunshine, and at the same time the wind sweeps completely over them. A further benefit is that the hens will be found to strip the heads of the grass, which the chicks devour greedily. For older birds he frequently has oats planted, and the ears are consumed whilst in a green state in the same manner. The period of cooping is about eight weeks, when the red usually begins to appear on the heads, and by this time the coops are moved gradually towards the perches or trees, when it is found that both the mother and her brood begin to roost there. Practically, by that time the difficulties of turkey-raising are at an end, for with the appearance of the red upon the heads the birds are much hardier than was the case previously. The treatment in summer is comparatively simple, as the birds roost either in the trees or in the house previously described.

In some districts where foxes and other enemies abound, it is necessary to take special steps to protect the birds. To this end, if the birds are kept in the open, the earth around the trees and under the roosts is thickly strewn with gas-lime and asafœtida, the pungent odour of which is generally sufficient to keep marauders from the birds without doing any harm to them. The gas-lime, however, must be renewed as frequently as is necessary, otherwise loss will result.

Feeding.—Stock turkeys may be fed in the same manner as prescribed for ordinary fowls, but we must not forget that they obtain a large amount of green-stuff and natural food during their foraging expeditions, and that supplied to them should be subsidiary. It is important in the case of the breeders to keep them in good condition, for which purpose full liberty is essential. The food provided may be any of the ordinary grains, but in addition a few peas or beans are very helpful, as they are low in fat and in carbo-hydrates. It is better to feed whole grain than soft food.

Young turkeys are first fed on hard-boiled egg, chopped fine, with boiled rice and soaked stale bread, or rice simmered in milk. The rice should be mixed when quite soft with sifted oatmeal, Spratt's meal, or ground oats, until it is crumbly moist. They should be fed five or six times in the day, the first feed to be as soon as possible after daylight, and the last about six o'clock in the evening. When a week or ten days old, gradually change the food, introducing barley-meal or ground oats mixed with middlings, also buckwheat or wheat (the latter should be boiled), and—most important of all—plenty of young onions chopped fine. Any kind of tender green food is useful, but onions are most valuable. Young clover, or lettuce, or dandelion, or nettles, can all be used with advantage. As soon as the birds have "shot the red," they may be fed upon green oats, wheat, buckwheat, and barley, varied with boiled wheat dried off with barley-meal. The great requisites for successful turkey-rearing are—(1) a dry, comfortable house and run; and (2) good and proper feeding. On cold or wet days mix a little seasoning in the soft food, and give every day for the first three months a little chopped meat or Spratt's crissel. Bone-meal or fresh bones should be mixed with the food, and there should be a plentiful supply of grit. It is necessary to move the coop every day, or the ground will become tainted. When the young birds are about a fortnight old, let the hen out of the coop for about an hour a day, which may be gradually extended in time.

A dry summer is most harmful to the turkey raiser, for then the supply of natural food and of green food is very scanty. Under these conditions a fuller diet is essential, chiefly in the direction of a more plentiful supply of green food. Those who have plenty of woodland will find a hot summer less harmful than where the land is more open, as the cool shade of the trees prevents the growth thereon being burnt up to the same extent. It is frequently noted that at Christmas turkeys run smaller in size than if the summer has been cool and moist.

Turkey Poults.—When in America, I was interested to note that a considerable trade during the summer is done in what are called "turkey poults"—that is, young turkeys killed when about ten weeks old, weighing 3 to 4 pounds, at which age they are very fleshy indeed and fine in flavour. The price realized was four to six shillings each, which ought to leave a large profit. I learnt that, as there is a considerable demand for these, many turkey breeders are accustomed to hatch a much larger number than they desire to rear for autumn sale, killing off all beyond such as are intended for Thanksgiving and Christmas, and thus considerably enhance their returns. I cannot but think that, if these young turkeys were offered for sale in Britain, they would be very popular indeed, and a great impetus be thus given to this branch of poultry husbandry.

Fattening.—Upon arable farms turkeys should be fed upon the stubbles, as they are splendid foragers, which means a great reduction of cost for food. Such specimens as are intended for use or sale as stock birds will continue to be fed in the same way as other stock poultry; but if they are to be fatted, it is desirable to get them into good condition, which can best be accomplished by putting them on to growing roots or cabbages.

This treatment is continued until about November 1, after which time they are fed, as soon as liberated in the morning, with soft food, usually consisting of ground oats, or barley and wheat meals. When satisfied, they wander off to the fields until feeding-time in the afternoon, when they are provided with all the food they care to eat. About November 20—that is, five weeks before Christmas—begins the final stage of the process. The turkeys are put up to fatten in a dry, comfortable shed, which must be large enough for the number of birds to be accommodated. For this purpose the form shown in Fig. 59 is the best type. Broad perches are used, which must not be more than 3 feet above the ground. These sheds are better if provided with open yards. Food and water are placed in troughs conveniently situated, and away from the perches. When put up to fatten, the turkeys are given all the food they will eat. The morning feed consists of barley-meal, wheat-meal, buckwheat-meal, or ground oats. Farmers who have good customers and produce the best birds mix the meals with soured skim-milk, and give milk to drink instead of water—an inexpensive addition, and one which considerably improves the flesh. Although not much used, there can be no doubt that the addition of a little pure fat—about ½ ounce per diem—to the soft food is highly beneficial, softening the flesh. Cooked potatoes can also be added with advantage. The afternoon feed consists of whole barley, oats, buckwheat, and a little maize, and these are more easily digested if steamed or soaked in hot water. When fully satisfied, all food should be removed, the troughs emptied both morning and evening, and washed after the morning meal of soft food. In every case there must be a plentiful supply of coarse grit and sand available to the fowls, and a little slaked lime or old mortar will be an improvement. Without grit the turkeys cannot possibly digest their food properly, and without effective digestion flesh production will never be complete. A supply of coarsely powdered vegetable charcoal should be provided. Turkeys can be crammed by machines, as are fowls; but this process is not necessary.

Killing and Dressing.—The usual method of killing a turkey is to first fasten the legs and wings with soft string, which must be strong enough to bear the weight. By means of that fastening suspend it to a beam, head downwards, so that the head will fall about midway on the operator's body. Pass the left arm round the turkey, so that its tail will point behind. Take its head in the right hand, with fingers under the throat, and thumb at the base of the skull; now give a sharp, sudden, strong jerk downwards, and a sharp twist upwards and sideways, and death will be instantaneous, though there may be considerable muscular exertion for a time. If it is thought desirable to bleed, that can be secured by cutting the throat; but this must be done at once. Turkeys can also be killed in the same way as fowls, already described.

CHAPTER XXI

EGG PRODUCTION AND PRESERVATION

THE growth within recent years of demand for and consumption of eggs has been phenomenal in nearly every country, more especially those wherein industrial and commercial developments have taken place to the greater extent. As a consequence, this stimulus to increased production has led to adoption of methods which were at one period scarcely contemplated. What may be termed "factory" systems have been tried in many countries, and are receiving a greater amount of attention than ever before. These are referred to in the earlier chapters. My present purpose is to consider the questions involved in detail, in order to show what progress can be recorded, together with the prospects of further development. It must be admitted that up to the present time the advance made has not proved equal to anticipations formed, for reasons which are stated below—that is, when we regard the question as a commercial proposition, in which the relation of cost in production to returns is the determining factor. No industry can be permanently successful except the margin affords a living profit. That is the problem awaiting solution.

Sources of Egg-Supply.—Experience in what may be termed "producing countries" shows that practically the only profitable method of egg production is in association with general agriculture, either by farmers or small occupiers. The few sporadic attempts made to establish special egg plants have failed. In the consuming countries the last-named have contributed a greater volume of supply. Even these, except in association with sale of breeding stock, etc., have not proved successful. It is an undoubted fact that in every country the main source of egg-supply is the ordinary farm, and that specialized production provides for but a small moiety of the national requirements. In the United Kingdom the latter is probably not more than 10 per cent. of the total consumption, inclusive of such as are produced by fowls in the hands of fanciers, amateurs, urban and suburban residents, and those who operate upon intensive lines.

The main sources of supply are, therefore—

1. *General Farms,* upon which no poultry specialization is attempted. That there has been considerable advance in this direction within late years is apparent, both as to number and nature of fowls kept and to methods adopted. From what is stated in Chapter II., it is evident that the capacity of the country is far from being reached. Under such farm conditions the cost of production is at the minimum. Even though the average fecundity may be considerably less than where more intensive methods are adopted, the profit is substantial. For that reason I have devoted the greater part of my time and thought to promote increased production on extensive lines as part of general farming.

2. *Special Poultry Farms.*—On these there is, and must be, a greater or lesser measure of intensification, which gives rise to difficulties, apart from the greatly increased cost of production, for which as yet no solution has been found. Something has been done, more especially by introduction of scratching sheds. I believe that more can be accomplished in the future, probably by a complete and entire dissociation of operations in breeding the pullets and producing the eggs. Upon present lines—namely, intensively breeding as well as intensively keeping during the laying period of life—I am more than doubtful as to the ultimate issue. In this direction there is much to be learnt ere we can hope to see any clear light.

3. *Cottagers and Allotment Holders.*—Whilst production under these conditions is individually small, it is considerable in the aggregate, and might be very much greater. In this case, also, the cost is small and the margin satisfactory. Every facility should be afforded to this class. Those who hinder or prohibit the keeping of poultry in rural districts by cottagers or agricultural labourers, as is sometimes the case, deserve the severest condemnation for their tyrannical action.

4. *Urban and Suburban Residents.*—Here, again, the number of fowls kept may be individually small, yet the total is great. Urban and suburban poultry-keepers mainly consume the eggs produced in their own households, so that these do not enter into the ordinary trade. That, however, is in itself a very important contribution to the national supply. As opportunities increase, which must be the case when our cities and towns are reorganized

on sounder lines, this branch will advance, although it will never become a great factor in feeding our people.

Improvements in Egg Production.—That there have been considerable developments in the average production of eggs by hens can be freely accepted. It is true that exceptional productiveness has always been known, as records abundantly testify. That in itself is not of moment. What we have to regard is the average production of an entire flock, not what a few will do in this way. If the latter can be used in the breeding-pen as a means of raising the former, then their value is increased a hundredfold. Consequently, to know which are the better layers is essential. My opinion is that the greater average production referred to is due to introduction of better laying races than formerly found, when the fowls were of a heavier type. In this respect, the influence exerted by Mediterranean and American races has been very great indeed. What has now to be done is to raise the average egg production of our fowls as well as to increase the number of layers. It is in that direction efforts have been mainly directed within recent years, though not as yet with the permanent results hoped for. Frequently some progress has apparently been made, but it was of a temporary character. My own view is that breeders are in too great a hurry. They have sought to accomplish in a year or two what would need a cycle of time, if even it were then possible. They have to learn how to make haste slowly. The lure of the 200-egg hen has led them astray. They have failed to realize that the hen which is the heaviest layer may be the least desirable as a breeder, and does not possess the power of transmitting this quality. Upon that question more is said below.

Factors in Egg Production.—Whatever the method adopted—whether extensive, intensive, or semi-intensive—there are certain factors which must be taken into account, each of which has its place. Probably there are others unknown to us. I do not discuss the question at great length, for the reason that actual knowledge is limited, and many observations and experiments are as yet incomplete. Hence positive knowledge cannot be claimed. Views long held are undergoing a process of reconsideration, whilst new theories are being tested. It is at present largely a question of ebb and flow.

There are, however, certain factors which have made for improvement, in some cases to a lesser extent than might have been hoped for. These are briefly dealt with below.

As already indicated, an undoubted improvement in the average egg production upon farms has taken place within the last three decades. To a large extent that is due to introduction of lighter-bodied races which are naturally prolific, and which, by their adaptability to new environment and responsiveness to good treatment, have proved of great value. Racially, therefore, these have helped in the direction indicated. At the same time, individual selection has also been more carefully carried out, and also, by getting rid of older hens in a systematic manner, instead of keeping for years, the average production has been raised. It is undoubtedly true that, when a hen is bred and fed for heavy egg production, her period of profit over the cost of maintenance does not usually exceed three years. As a rule she is most prolific in the first breeding season, decreasing by about 25 per cent. in the second, and to a like degree in the third year, in each of which latter she is more valuable as a breeder. That any progression which may be made will depend largely upon racial and individual selection cannot be doubted.

A further influence which has operated in the same direction is the improvement of environmental conditions. Modern poultry houses are vastly superior to those formerly in use. Instead of the close, crowded, ill-ventilated roosting-places at one time general, adoption of spacious scratching sheds, open-fronted, light, and airy, has done much to improve fecundity. Upon that point references are made in Chapter XI., to which, however, may be added that an adequate supply of oxygen is essential to the complete digestion of food, and that with the larger amount of nutritive elements required, as the number of eggs produced is increased, the consumption of that element is necessarily larger.

The effect of changed conditions is also stimulative in this direction, though that is not always the case. Most changes, however, are favourable. It is often found that production, either of eggs or of flesh, is enhanced when transference takes place from one country or one district to another—at any rate, for the first two or three generations, when the influence appears to lose its effect to some extent. That explains to a degree why a breed is usually more prolific in a new environment than was the case in its original habitat. If that is correct, it would strengthen the practice of regularly obtaining fresh stock.

Feeding exerts a powerful influence, and may be beneficial. Excess of food tends to reduction of fertility and also of fecundity. If plain and containing the egg constituents without an undue amount of fat, the instinct of fowls may be trusted to determine quantity. Upon this aspect of the question our knowledge is superficial as yet, although some progress has been made. Frequently food is supplied in a form which, by tempting the appetite, hinders production. Even where that is not the case, it is possible to increase the number of eggs at a cost which makes the doing so unprofitable.

Above all is the question of constitutional vigour. Weakly hens are sometimes good layers. Where that is the case they usually consume more food, so that the expense is enhanced. If used as breeding stock, the progeny will assuredly suffer, making for the degeneracy referred to in Chapter IV.

Unexhausted Capacity of Hens.—An idea has been generally prevalent that a hen could not lay more than about 600 eggs during her whole period of life. If she produced a larger number in her first or second year, the ovaries would be more rapidly exhausted; if fewer, then she might continue to be profitable much longer. Whence this theory arose need not concern us. That it has had considerable acceptance is undoubted. Dr. Raymond Pearl has clearly shown* that it has no basis whatever. Professor James Dryden, of Oregon, records that one of his White Leghorn hens laid 664 eggs in three years—namely, first year, 240 ; second, 222 ; third, 202—and that in another case 691 eggs were laid in four years. Dr. Pearl mentions a Leghorn hen with a total of 969 eggs in seven years—1902, 105 eggs; 1903, 163; 1904, 138; 1905, 159; 1906, 160; 1907, 133; and 1908, 111; thus averaging upwards of 138 eggs per annum.

These figures apply to eggs actually produced. What is of importance is whether there is any latent capacity upon which breeders may hope to draw. Until recently no data was available in this direction. In the report of the Maine Station referred to, Dr. Pearl records observations made by Miss Maynie R. Curtis as to the number of oöcytes, or ovules, visible to the naked eye, found in fifteen hens killed after laying had commenced, to which were added the number of eggs already produced, the winter production, and the discharged follicles, the latter of which indicate that many oöcytes are discharged that do not form eggs. (See table on p. 351.)

From the table is seen that the number of oöcytes in the nine Plymouth Rocks averaged 1,519·77; in the four White Leghorns, 2,475·75 ; in the Cornish Game, 1,550 ; and in the cross-bred, 2,000. The variations of individuals in the two leading breeds are, however, very great, indicating that there is no fixity. What we learn is that the latent egg capacity in all these hens was very great.

* Report of Maine Agricultural Experiment Station, 1912.

Upon the observations made Dr. Pearl says: "The data now in hand, even at the very lowest valuation which may be placed upon them, indicate clearly that there must be some other factor than the anatomical one involved in the existence of different degrees of actual fecundity in the domestic fowl. It clearly is the case from that table that, when one bird has a winter record of twice what another bird has, it is *not* because the first has twice as many oöcytes in the ovary. On the contrary, it appears that all birds have an anatomical endowment entirely sufficient for a very high degree of fecundity, and, in point of fact, quite equal to that possessed by birds which actually accomplish a high record of fecundity. Whether or not such high fecundity is actually realized evidently depends, then, upon the influence of additional factors beyond the anatomical basis. It is reasonable to suppose that these factors are physiological in nature."

NUMBER OF VISIBLE OÖCYTES IN OVARIES.

Breed.	Date hatched.	Date killed.	Total Number of Eggs laid in Life.	Winter Production.	Discharged Follicles.	Total Visible Oöcytes.
	1910.	1911.				
Barred Plymouth Rock..	June 1	Mar. 28	10	3	17	1,226
,, ,, ,, ..	,, 2	,, 30	10	0	12	1,666
,, ,, ,, ..	,, 1	,, 10	7	0	8	914
,, ,, ,, ..	,, 2	,, 14	17	5	12	1,174
,, ,, ,, ..	April 28	April 4	34	3	49	2,306
,, ,, ,, ..	June 2	Mar. 24	16	0	23	1,194
,, ,, ,, ..	,, 2	,, 24	15	0	17	2,101
,, ,, ,, ..	May 19	,, 17	19	5	24	1,576
	1909.	1910.				
,, ,, ,, ..	Mar. 30	July 7	23	0	21	1,521
White Leghorn	May 18	Dec. 20	198	54	75	2,452
,, ,, ...	,, 28	,, 15	197	32	217	3,605
,, ,, ...	,, 21	,, 13	10	0	11	1,701
,, ,, ...	June 14	,, 22	2	0	43	2,145
Cornish Indian Game ..	April 21	July 12	52	13	54	1,550
	1910.	1911.				
Cross-bred	Mar. 31	Mar. 20	124	106	50	2,000

Parental Influence.—At one period the common practice among farmers and ordinary poultry-keepers was to introduce among their general flocks of fowls pure-bred males. When carried out upon a systematic basis — which was very seldom — the effect was considerable. Where it failed was owing to the fact that the males were selected for racial characters rather than inherent productiveness, and that arbitrary changes of breed took place, frequently in accordance with fashion or fads. As a result, apart from increased vigour due to crossing, the influence upon fecundity was small as a permanent factor. It may be pointed out that, in the breeding of farm animals of all kinds, the male is regarded as more than half the strain, and that the greater efforts for improvement are in that direction.

Then came the time of the trap-nest, by introduction of which the supremacy of hens in respect to productiveness was at once accepted, almost without question. Records obtained in this manner were startling in the extreme, revealing the fact that variability in fecundity was greater than had been thought. Pullets bred from the same parents, at the same time, and treated in the same manner, were found to range to an enormous extent in the number of eggs individually produced. It was at once assumed that elimination of the drones, and breeding from the most prolific, was the true method of rapidly advancing the average of the whole. Results, apparently, for a time justified this assumption. Unquestionably, improvements were effected for two or three years, in some cases longer. Then reaction took place, more especially where operations were on a larger scale, and averages fell to or below the original mean of the race. This was not, however, always the case, as indicated by what has been accomplished in the hands of a few breeders in Europe, America, and Australia. Where that has been true, it is evident an equal amount of selection has taken place with male birds chosen as breeders, sons of hens which were heavy layers. In that direction we should probably find explanation of the success attained. My own view is that the great mistake has been in using for breeding purposes the excessive layers. It is almost an invariable rule that the extreme or exceptional individual, in which any quality is found developed to the highest point, has not the power of transmitting this quality to its progeny, and that as a breeder it is of less value than those which approximate to the mean of the race. All the time a tendency to regression is present. Any weakening of natural vigour due to abnormal production, by reduction of the overstrained force, makes for that regression. In my judgment that is where a serious mistake has been made within recent years.

Dr. Pearl's Investigations.—What must be termed the failure of the trap-nest to accomplish all that was anticipated, due to unwarranted reliance upon its records, and to the use of hens exhausted by excessive production, although such records are essential and valuable in the extreme, has led to investigations regarding the problem of fecundity, which, whilst incomplete, promise to help in finding a solution, unless they, again, are not carried to an extreme. In this work Dr. Raymond Pearl, of Orono, Maine, occupies the leading position. His researches form the most notable contribution to poultry husbandry hitherto made. Operating on extensive lines, and with records covering several years, the material available has enabled him to take broad views of the subject.

For present purposes it will be sufficient if a brief summary is given of the conclusions arrived at by Dr. Pearl, which are as follows:

The record of fecundity of a hen, taken by and of itself alone, gives no definite, reliable indication from which the probable egg production of her daughters may be predicted. Furthermore, mass selection on the basis of the fecundity records of females alone, even though long-continued and stringent in character, failed completely to produce any steady change in type in the direction of selection.

Fecundity must, however, be inherited, since (1) there are widely distinct and permanent (under ordinary breeding) differences in respect to degree of fecundity between different standard breeds of fowls commonly kept, and (2) a study of pedigree records of poultry at once discovers pedigree lines (in some measure inbred, of course), in each of which a definite, particular degree of fecundity constantly reappears generation after generation.

High fecundity may be inherited by daughters from their sire, independent of the dam. This is proved by the numerous cases where the same proportion of daughters of high fecundity are produced by the same sire, whether he is mated with dams of low or of high fecundity.

High fecundity is not inherited by daughters from their dam. This is proved by a number of distinct and independent lines of evidence.

A low degree of fecundity may be inherited by the daughters from either sire or dam, or both.

Results show that, on the average, the daughters of birds laying from 150 to 190 eggs in the year laid much better than the daughters of "200-egg" hens. This result is, obviously, of great importance in its relation to the general question of the effect of selection for increased egg production.

Continued selection of highly fecund females alone could not even be expected to produce a definite and steady increase in average flock production. The gametic constitution of the male plays so important a part in determining the fecundity of the daughters that any scheme of selection which left this out of account was really not systematic at all, but, rather, almost altogether haphazard. It has been repeatedly shown that the same proportion of daughters of high fecundity may be obtained from certain mothers of low fecundity as can from those of high fecundity, provided both sets of mothers are mated to males of the same gametic constitution.

To apply what is stated above, the conclusions arrived at are that the male influence in egg production is more potent upon immediate progeny than that of the female, and that selection of such male from a family of heavy layers is of supreme importance. Whether mating with low-fecundity hens, even though the first generation of pullets may be good layers, will not result in reaction, as I suggest would probably be the case, is a question for further and prolonged investigation. Breeding from abnormal layers results in rapid regression. As I have stated previously, it is not the heavy layer that is valuable for breeding, but the parents from which she sprang.

Application.—So far as the great mass of farmers and ordinary poultry-keepers are concerned, from what is indicated above, and by complication of the problem, it cannot be expected that these can carry to a conclusion the methods necessarily to be adopted. In the main, trap-nesting is not within the compass of their operations, demanding more time than they can afford to give, considering the possible returns. Moreover, the need is less imperative than in the case of specialist poultrymen, by reason of the fact that, as already shown, the cost of feeding and production is much less than must be the case with the latter, to whom an increase of average number of eggs may mean success, and its absence betoken failure. Those who attempt egg production on wholesale lines would find it necessary to give attention to these problems, and attempt at least to apply the methods suggested in their breeding. Where the general poultry-keeper will realize any improvement in breeding which may follow their adoption will be by buying stock, and especially male birds, from specialists who apply such methods in breeding. Opportunities in this direction are greater than ever.

What must, I am firmly convinced, ultimately come to pass is a division of operations between production of breeding stock and of eggs for eating, and that it is inadvisable to use for reproductive purposes those hens which have proved most prolific as layers. Only in this way can permanency be secured. Massing for egg production may be possible; massing for breeding never has been, or, I believe, will ever be. The two must be kept distinct.

Effect of Early Laying.—Within the compass of every poultryman, whether large or small, is increase of average egg production by enhancement of winter egg production, for the reason that hens which lay most eggs at that season during their first year are, almost without exception, those which prove to be most productive. In this manner much may be accomplished without attempting to enter into the problems of breeding already referred to.

Dr. Raymond Pearl has based many of his observations upon fecundity in the winter period, on the ground that " the production during the months of March, April, and May, is practically worthless as an index or measure of the true, innate, or constitutional fecundity capacity of the individual. During all these months (in northern latitudes) all hens which are not diseased, malformed, infantile, or senile, lay anywhere from well to very well." Upon this most important point further valuable evidence is forthcoming.

In the Twelve Months Laying Competition of the Utility Poultry Club, 1912-13, wherein were 600 competing birds, the following results, taken from the published report, are recorded:

Average Egg Production for Complete Year of Birds commencing to lay at Different Times.

Birds which laid 10 or more eggs in first four weeks (October 15 to November 12)	187·5
Birds which laid at all in first four weeks	167·7
Birds which did not lay in first four weeks	161·4
Birds which did not lay in first eight weeks (October 15 to December 10)	155·8
Birds which did not lay in first twelve weeks (October 15 to January 7)	106·5

At the Munster Institute, Cork, a similar competition was held in 1912-13. In this case the results are even more suggestive—namely:

Eight hens which produced an average of 57 eggs in first three months (November, December, and January) averaged in total year	206·00
Eight hens which produced an average of 19·99 eggs in first three months averaged in total year	96·25
Eight hens which produced an average of 1·25 eggs in first three months (6 did not lay at all) averaged in total year	47·88

Other facts, doubtless, had an influence in all these cases. The fact, however, is evident that an increase of production in the winter period is accompanied by a total increase for the entire year. That simplifies the process of selection, as it is only necessary to trap-nest for, say, four months out of the twelve.

Trap-Nesting.—As a means of determining the fecundity of hens, with a view to obtaining data referred to already, what is known as the trap-nest is valuable and indispensable. The principle is the same—namely, the hen enters a box with a trap to lay her egg, but cannot get out again until released. By the use of leg-rings or bands—of which the best form is the coloured celluloid rings made by Hills Rubber Company, of Reading, Berks, which firm have devised a complete code by ten colours, the variations of which enable large numbers of hens to be distinctively marked—the eggs laid by each individual hen are credited to her on forms prepared for that purpose. Thus, tables can be prepared showing results for each period of and the entire twelve months. The work entails labour, and should only be applied to selected birds. It, however, reveals facts which the breeder must know for guidance in his breeding operations.

Winter Egg Production.—In order to obtain the best results in egg production, it is most important that winter laying be increased. Great numbers of the pullets hatched in this country do not begin operations until after Christmas, and thus the best part of the winter egg trade is altogether missed. It ought to be the ideal in the minds of all poultry-keepers to have each individual pullet laying by November 1, which can be accomplished provided that the birds are hatched early enough, and at the same time are reared in a proper manner. It is impossible in this connection to lay down any hard-and-fast rule, because a great deal depends upon the nature of the breed kept, the class of soil, and the method of rearing. Upon heavy soils chickens do not grow so quickly as upon the lighter lands, and the same is true as to the more exposed and colder parts of the country. In respect to the different breeds, we can hatch, say, Leghorns a month to six weeks later than Wyandottes, and they will commence laying before the Wyandottes. Thus, each poultry-keeper must experiment for himself.

There is another advantage which arises from bringing pullets on early—namely, that we secure sitting hens much sooner than would otherwise be the case; and, further, the following year these pullets will moult earlier and come into lay again sooner than do the later-hatched specimens.

The points for breeders are—(1) Early pullets; (2) young birds; (3) not to break off sitting hens in the summer, as the rest is beneficial; (4) careful selection in breeding; and (5) the choice of winter laying (general purpose) breeds.

Profit Attainable.—Upon the question of cost of egg production there are many different opinions. Up to the present time observations in this direction are limited, and in many cases not very reliable. Much must necessarily depend upon economy in feeding and in management. Frequently such statistics as are available are either from small poultry-keepers, whose households supply a by no means small portion of the food required, or, on the other hand, from those who feed expensively, and are compelled to pay for labour. We have evidence to show that, where operations are conducted upon a sufficiently large scale, when the fowls are able to forage for a large part of their food, and grain and meal are purchased in the cheapest markets and fed judiciously, a flock of hens can be maintained at a cost not exceeding 4s. to 5s. each per annum. Whatever expense is incurred beyond the figure named is unnecessary.

To pay such a charge, each hen must produce in the twelve months forty to sixty eggs, according to the season of the year when laid, before profit can be hoped for. The reward of the poultry-keeper will depend upon the number of eggs secured in addition thereto. If the average production is not more than sixty eggs per annum, whilst there will be no loss, gain will not be realized. If he secures an average of 100 eggs per annum, he should find a margin of 3s. per hen; but if 120 be the average, 4s. 6d. per hen will reward his efforts; whereas if he secures an average of 160 eggs, then he may fairly expect a profit of 7s. 6d. per hen. That should be the objective of every poultry-keeper.

In this connection we have not counted the cost of the stock. If the work is properly systematized, the laying hens should practically cost nothing. Upon a farm where 500 laying hens are bred, half should be renewed every year, and hence it will be necessary to breed 500 to 600 chickens, of which probably half will be pullets. If bred at the right season, the cockerels can be sold off at 2s. to 2s. 6d. each, and that amount should pay the cost of rearing two birds, so that the pullets at three to four months old will have cost practically nothing, and the additional feeding to bring them to the time of profit will be more than compensated by the sale of the old hens.

Size of Eggs.—It may be true that "an egg is an egg," no matter what its size, shape, colour, or age, may be. At the same time, however, we have to take into account market requirements, and to consider what is needed in order to obtain the best returns. This question is discussed in the next chapter.

The question arises as to whether anything can be done to improve the size of eggs. Some breeds of poultry naturally lay large eggs, notably the Minorca, Andalusian, Dorking, and Scotch Grey; and in some cases these eggs are, if anything, rather too large for the trade, to which reference has already been made. Still, the fault is on the right side, and where these breeds are used pure or as crosses their influence will help considerably in the desired direction. Those classes of poultry which meet market demand most nearly are Campines, Leghorns, Anconas, Houdans, Plymouth Rocks, and Orpingtons. Several of our most prolific breeds of poultry—notably the Hamburgh and the Wyandotte—lay eggs which are distinctly smaller in size.

There is, however, at hand a method of improving the size of eggs, as it is possible with every breed to modify considerably the weight of egg, either in a forward or backward direction. The system is a simple one—namely, by selection of the eggs for hatching. It will be easily realized that if, in order to secure early birds—which in itself is often a very important point—we take the eggs just as they come, and these be small, we emphasize that tendency, as we are breeding from the hens which naturally lay the smaller-sized eggs. It ought to be an axiom with every poultry-keeper never to set either an abnormally large or small egg, unless it is intended to kill the chickens at an early age, when size is of lesser importance. A further tendency towards the perpetuation of small-sized eggs is due to the practice, which so many people follow, of hatching from eggs produced by young pullets. This is a mistake, and, as far as possible, breeding and laying stock should be descended from hens fully matured—that is, not less than eighteen months old.

Colour of Shells.—In some home markets the highest price can always be obtained for eggs which have a tinted shell, and the best class of traders find that these eggs are almost constantly inquired for by their customers. In spite of the fact, which is generally acknowledged, that the colour of the shell does not indicate the quality of the egg, and that a white-shelled egg produced under the same conditions is as rich and has an equally nutritive value as the egg having a tinted exterior, the preference indicated above must be taken into account, otherwise —especially during the plentiful season—the same price cannot be obtained in some markets for eggs which are all white as when there is a considerable proportion of tinted shells. Amongst the best class of consumers, where boiled eggs are simply an item on the breakfast-table, there can be no question that a nicely tinted-shelled egg looks better in a silver stand than one which is pure white, and appearance must always be taken into consideration.

The breeds which produce tinted-shelled eggs are without exception sitters, although there are certain breeds which evince the maternal instinct that produce white-shelled eggs. The following list will show the breeds which give tinted shells amongst those commonly kept, and they are placed as far as possible in accordance with the depth of the tint:

Langshans.	Wyandottes.
Cochins.	Brahmas.
Plymouth Rocks.	Faverolles.
Orpingtons.	Coucou de Malines.
Game.	Rhode Island Reds.

In addition to these, there are other breeds which are not kept for egg production, notably the Indian Game and the Malay. We must therefore look, in the first instance, to the above breeds to give us the tinted shells, either by keeping stock pure or by using these breeds for crossing purposes.

Preservation of Eggs.

It is a little more than a hundred years ago that the first recorded patent was taken out for the preservation of eggs—the Jayne method of lime-water, which is still largely used. Since that time a multitude of other systems have been brought forward, some of which have proved successful, but the great majority either offered no advantages over those already employed, or were commercially impracticable. Until the problem of enhanced winter egg production is solved, preserved eggs we want, and must have. Were it not for these, the prices of eggs from September to January would be prohibitive.

Object of Preservation.—As the spring has been, and always will be, the time of year when eggs are produced in the greatest number and prices range lowest, the object of preservation is to transfer a portion of the supplies from the plentiful to the scarce, from the cheap to the dear season; not only to secure the higher rates then obtainable, but to avoid glut by removing the surplus. As is stated in my "Report on the Poultry Industry in Denmark and Sweden," "Not only is the trade in preserved eggs profitable in itself, but, by relieving the glut during the spring, those sold at that season of the year command much better prices than if forty to fifty millions more Danish were placed on the market." It is freely acknowledged in Denmark that the success achieved would never have been realized had not preservation been adopted.

Who should Preserve?—Discussion has often arisen as to who should undertake the work of preservation. In many Continental countries, in America, and to a lesser extent at home, this is done by private traders or companies, who purchase eggs as a speculation, hold them for the necessary period, and sell at such time as they think well to do so. That the benefits to producers are considerable is apparent. The enhanced demand thus secured has increased spring prices, which is due to the fact that large quantities have been taken off the market, and have thus prevented the lower rates which would otherwise have prevailed. In connection with local co-operative societies in the United Kingdom, as in Denmark, preservation takes place in the locality where the eggs are produced, so that supplies can be put down at an early date after they are laid. When the work is undertaken on a large scale at a few centres, the eggs are drawn from a wide area, and, consequently, they are stale before storage takes place. My observations in Europe and America have shown that frequently the eggs are from ten to twenty days old ere the process is commenced. Under such conditions results can hardly be satisfactory. Hence preservation should be undertaken by poultry-keepers themselves or by co-operative depots or traders in the immediate localities where the eggs are produced.

When to Preserve.—Much depends upon the time of year when the eggs are put down. My advice has always been to sell for present consumption whenever a reasonable and profitable price can be secured. Hence it is largely a question of surplus. Apart from the price, which is an important factor, as it is useless preserving unless there is a margin of profit, eggs are better in every way, both as to quality of contents and strength of shells, during the natural laying season. The best months are April and May. Experience has shown that the eggs laid during those months keep better than those obtained before or after. Prior to the middle of March, and from June onwards, prices do not usually allow profit to be secured. Moreover, summer eggs seldom keep as well as those laid in the spring, even though preserved for a shorter period.

What to Preserve.—The final result, so far as quality is concerned, depends largely upon the method of preservation adopted, upon the conditions under which the eggs are kept during the entire period, and on their treatment after they are taken out for sale; but, however perfect all these may be, they will utterly fail unless, when subjected to the process, eggs are of first-rate quality. It is this fact which is so often forgotten, more especially by producers and traders who operate on a small scale. A really new-laid egg, provided the conditions are favourable, will come out six months later excellent for cooking purposes, having, however, lost something of its pristine value;

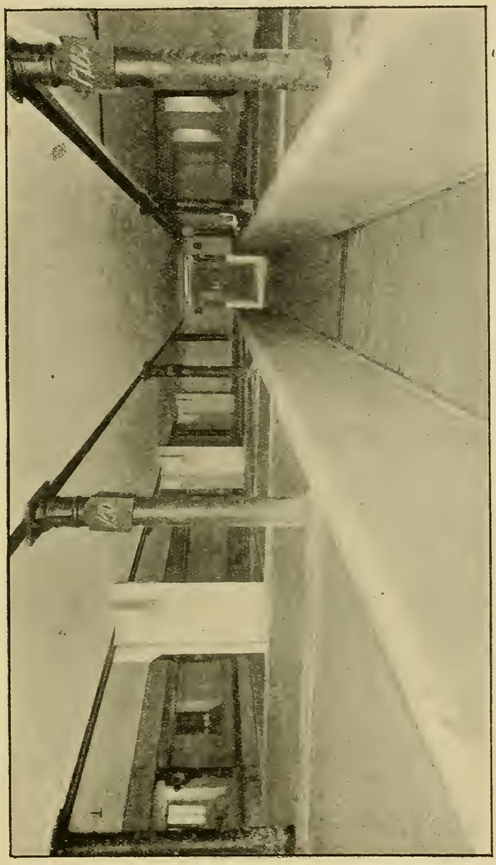


Fig. 61.—Preservation Tanks.

whereas a second-quality egg will emerge with even a greater loss, and therefore inferior by so much to the first. A stale egg will probably come out bad, totally unfit for food. Hence it is all-important that the eggs selected for this purpose shall be really fresh, chosen because they are full, strong in the shell, well formed, and sound in every way. The slightest flaw or crack will be fatal. Every egg should be carefully and rigidly tested before it is preserved, and all those which cannot grade as new-laids should be sold for immediate consumption. As already stated, it is in this respect that many Continental and American eggs fail.

A further point is that infertile eggs keep better than those which contain a living germ. That has been known for 2,000 years, and later experience, more especially in connection with supplies from South Australia, have fully confirmed its truth. If farmers and others would keep separate breeding-pens, using eggs from these for hatching, removing the males running with the ordinary laying stock from March onwards, such eggs as are preserved would turn out much better than is the case at present.

Where to Preserve.—The temperature to which the eggs are subjected during the preservation period will exert considerable influence for good or evil. It should be remembered that they have to pass through the hotter months of the year, when the tendency in all buildings above-ground is to rise above the safe point, unless they are kept in cold storage. More than 40° F. means change in the egg contents, and the higher the temperature the more rapid the change. For that reason preservation generally takes place in cellars, either wholly or partially below-ground, and any windows or ventilators should be on the north or north-west side, so that the sun's rays may not find access. One preserving plant which I visited at Aarhus, in Denmark, was entirely under-ground, and with a mass of buildings above and on the south side, so that, entering on a summer's day, it felt almost like an ice-house. Here the eggs are accommodated in large cement tanks, each holding about 70,000. These tanks are about 10 feet square and 5 feet deep. The cellars are well ventilated, and practically the temperature is equable all the time. This is typical of many cellars I have visited on the Continent, both in Eastern and Western Europe. Eggs may be kept in galvanized iron tanks, each holding about 5,000. These are convenient where quantities are not very large, as they are soon filled, and thus are not disturbed until the time comes for sale. They cost about 25s. each. As this system grows, it will be found profitable to build special cellars for the work, as in Denmark and elsewhere.

Methods—1. *Buttering.*—Those who only intend to keep the eggs a few weeks for home consumption will find it enough if they butter the eggs—that is, rub a little fresh butter over the shell, and store in a cool place. Or they may use glycerine or any sweet fat for the purpose, taking care that the shell is coated.

2. *Lime-Water.*—This, the oldest method used, is probably employed more than all other systems combined. The great bulk of Continental eggs received in water are "limed." It has also the practical merit of being the least expensive. For large operations I have no hesitation in saying that it is to be preferred, in spite of the fact that the shells are thickened by deposits of lime thereon. An advantage to retailers and consumers is that the fact of "pickling" is revealed by the rough shells. The solution is formed by mixing freshly-slaked lime with water—say 1 pound to 2 pounds of the lime to each 5 gallons of water, stirring it well two or three times a day until the whole forms a milky fluid, when 1 pound of salt is added to the above quantities. After standing a few hours to settle, the liquid is poured into the vats or tanks or tubs, whichever are used, when they are ready for the eggs. It may be observed that the virtue of the lime, as of the silicate of soda referred to later, is to kill all life in the water, which thus keeps sweet and pure. The quantity required is not so great as might be imagined, and if the tank is one-quarter filled at first, more can be added as required. The eggs should not be less than 4 inches from the top, so that they may be entirely covered by the liquid, which forms a skin or film, and prevents dust or dirt reaching the eggs.

3. *Water-Glass.*—For smaller operations the system which has become most popular is by means of what is popularly called "water-glass," which is a solution of silicate of soda, the value of which for this purpose was discovered some years ago by a German chemist. The results obtained are excellent—quite equal to those of lime-water, without thickening or roughing the shell to the same degree. The shells come out clean and fresh-looking. The solution is generally sold of full strength, and a 5 per cent. mixture is about right—that is, 5 per cent. of water-glass to 95 per cent. of water. The latter should be pure, and preferably boiled, mixed hot, but allowed to become quite cold before use. It has been found that a stronger solution affects the flavour of the eggs. A desirable plan is to fill the tanks three-quarters full with a solution consisting of $\frac{3}{4}$ pound of water-glass to each gallon of water, and, when the eggs are all in, add to the top a solution of 1 pound water-glass to the gallon. This method is more expensive than lime-water. Small quantities bought in

time will cost about 1d. per score eggs; but as the silicate of soda can be purchased in bulk at about 8s. per hundredweight, for large quantities the cost, apart from labour of preparation, of preserving fluid will work out at 1s. per 1,000 eggs. Lime-water in many districts would not cost more than 1d. to 1½d. per 1,000.

4. *Cold Storage.*—I do not need to say much under this heading, in spite of the fact that in Canada and the United States it is largely and almost universally adopted. It requires to be carried out by speculative traders or companies, and on a large scale. Nor have the results been satisfactory, as there is a strong tendency to the formation of moulds, and eggs preserved in this way go bad rapidly after they are brought into the normal temperature. Something has been done to improve this weakness, but when eggs have to be retailed out in half-dozens other methods of preservation are superior. The best temperature at which to keep the eggs is 29° to 30° F. There must be a constant circulation around them of pure, fairly dry air, and, when removed, it seems to be necessary to change from one room to another, each slightly warmer.

5. *Other Methods* need not concern us here. A method has been recently introduced by which air is exhausted from the egg, which is then dipped into hot paraffin wax. That is only suitable for adoption on a large scale, as a special plant is required, and the patent is in private hands. Such "sealed" eggs as I have seen were very good indeed.

How Long to Keep.—The time of sale of preserved eggs is from September to January, and hence six months is the average period for which they are kept. Observations made by Mr. J. Henrick, B.Sc., of the Aberdeen University, have shown that with water-glass longer keeping causes changes which would make the eggs undesirable as food. In America much trouble has arisen from holding eggs over to another year. That is undesirable in every way, and eggs should be consumed in the autumn following their preservation, whether the price realized be profitable or otherwise.

After Preservation.—When lime-water or water-glass is used, the tanks can be emptied rapidly by use of a perforated scoop with turned edges, because the liquid acts as a buffer, preventing breakages if handled gently. The operators should use india-rubber gloves and gauntlets. As they are taken out, the eggs are well washed in running water, and then placed upon wire trays, which may be stacked after draining to dry, which soon takes place if they are in a good current of air. Finally, before packing, they should be rigidly tested, so as to remove all that are bad or doubtful; and in all cases they should be sold as preserved eggs.

Infection of Eggs.—Modern systems of preservation, more especially by cold storage, have revealed moulds and bacteria which develop under these conditions. The most serious of these are known as " red rots " and " black rots," the former of which is supposed to be the result of exposure to cold and damp, such as a wet nest or packages, and by bacterial penetration of the shell. It is very contagious, one egg so affected spreading infection to others. Black rot is thought to be a result of ovarian or embryonic action. Moulds are due to vegetable growth arising in low temperature. All eggs, therefore, should be tested in strong light before preservation, and any showing reddishness in the yolk be rejected. Also, testing should take place before sale.

CHAPTER XXII

DISPOSAL OF PRODUCE

PRODUCTION of any class of food is but part of the work of feeding our great populations. Equally important is that of organization, so that supplies may be brought to the consumer in the best possible condition, in the most expeditious manner, and at the least cost. The complexity of our modern life, with vast aggregations of people unable to produce their own food-supplies, have at once added to the difficulties of the problem, increased cost by reason of the services rendered, and at the same time created a demand which formerly was unknown. As a consequence of changed conditions and inadequacy of home supplies of eggs and poultry, the imports of these two products have grown enormously. What is true in the United Kingdom is equally the case in Germany, and apparently is becoming so in the United States of America. In Chapters I. and II. the question is discussed, and need not be further dealt with, as the facts stated are generally recognized.

A Producer's Question.—Manufacturers recognize that organization for the sale of their goods is essential to complete success, and, as far as possible, keep the control within their own hands. That explains the important place occupied by trading members of the community. A good salesman can command his own price, which he well earns. Such was, and is to a considerable extent, the weak point of our present agricultural system. The Danes solved the problem by the adoption of co-operation; the French, Russians, and later the Dutch, by private traders. What we have to recognize is that marketing is a producer's question first and last. Any loss arising as a result of bad methods falls upon him, to the greatest extent where his operations are small, and he has no alternative outlets available. Those who undertake the work of distribution must be remunerated for their services. Consumers will not pay more than what they think an article is worth, preferring to go without. Hence the return which the poultry-keeper will receive for his goods is determined by the ultimate value, less the intermediary expenses and profits. As that value is largely a question of quality and conformity with market requirements, a study of the latter is necessary. The object of all engaged in poultry husbandry should be to obtain the highest possible returns, which can alone be by supplying the higher qualities and meeting the requirements referred to. Until this side of the work is generally reorganized, poultry-keeping will not realize its full development. That there has been a steady rise in the standard of quality in eggs and poultry—the former especially, as the need was greatest—within recent years, is unquestionable. That there is much yet to be accomplished is equally correct.

The Egg Trade.—Taking eggs in the first place, the demand is a very variable one. There are, however, principles which may be generally applied. What has not been sufficiently recognized is their nature, which may be stated as follows:

Eggs form a perishable product.

Eggs rapidly deteriorate, varying somewhat in accordance with the conditions under which they are kept; but nothing can prevent deterioration.

The egg contents change in accordance with the time they are kept.

Eggs decrease in value every day after they are laid.

Not every new-laid egg in point of time is a first-quality egg.

Appearance, as in everything else, has considerable money value in eggs.

That in some districts the quality standard is lower than in others is recognized. Where that is the case prices are correspondingly lower. As freshness is largely determined by the period which elapses between the time of laying and when finally sold to the consumer, in which distance to travel and methods adopted in marketing have great influence, it is evident why producers within a reasonable radius of the point of consumption can, if the system adopted be favourable, supply a quality which is impossible to those at a greater distance. Negligence, however, sacrifices a large portion of this advantage. Apart from preserved eggs, which come under another category, distance is a supreme factor, and explains why values decrease as the radius of supply increases. Of imported supplies, the following are the minimum periods in which eggs can reach our markets from the time of laying: French and Dutch, 4 to 6 days; Danish, 7 to 9 days; Italian and Austro-Hungarian, 14 to 21 days;

Russian, 28 to 40 days. Except those received from the first two countries named, no imported egg can possibly be of the first quality.

Grades of Eggs.—In the better retail trade eggs are classified as follows:

1. New-laid, 3 to 5 days old.
2. Breakfast, 6 to 10 days old.
3. Fresh, non-preserved, which may be a month old or more.
4. Cookers, in autumn generally preserved, or brought from the more distant countries.
5. Nondescript, inclusive of small eggs and preserved.

Only Nos. 1 and 2 are fit for boiling, which is the supreme test of quality. No. 2 are largely used for poaching or frying. An egg that would be objectionable if cooked in the shell can be used when broken out, by reason of escape of the gases accumulating therein as a result of greater age.

Quality Test for Eggs.—The following notes, which were first published in the *Illustrated Poultry Record* (December, 1910), and afterwards widely disseminated as a leaflet, show what are the methods of determining quality in an egg:

1. *Size.*—Many eggs weighing $1\frac{3}{4}$ ounces are of equal nutritive value to others which weigh $2\frac{1}{4}$ ounces, as the larger volume is almost entirely water. During the greater part of the year, whilst an egg scaling at $1\frac{7}{8}$ ounces is only 6·25 per cent. less in weight than one turning at 2 ounces, and probably contains as much actual nutriment, its retail value is 12 to 15 per cent. less, and generally is sold for cooking. Consumers demand, and retailers must supply, eggs which each weigh at least 2 ounces —*i.e.*, 15 lb. for 120, or over ; and in some markets 17 lb. eggs are preferred.

2. *Shape.*—In this respect there are considerable differences. Some eggs are long and narrow, others almost as broad as they are long, while still more are between the two. The last-named are preferred, though this is not of great moment, so long as the shell is even and not abnormal. Anything in the direction of malformation militates against the value.

3. *Evenness and Strength of Shell.*—Roughness of the outer envelope is undesirable. In the autumn and winter a rough shell generally denotes preservation by lime-water. Therefore the smoother the better. A strong, thick shell may mean that the proportion of edible matter to the total weight is less than is the case when the calcareous covering is thin; but such is more

than compensated by the fact that there is lesser evaporation if the shell is close and thick, and the carrying quality is greater.

4. *Bloom*.—A new-laid egg has a bright, shiny coating to the shell, which is called "bloom," and experienced buyers can

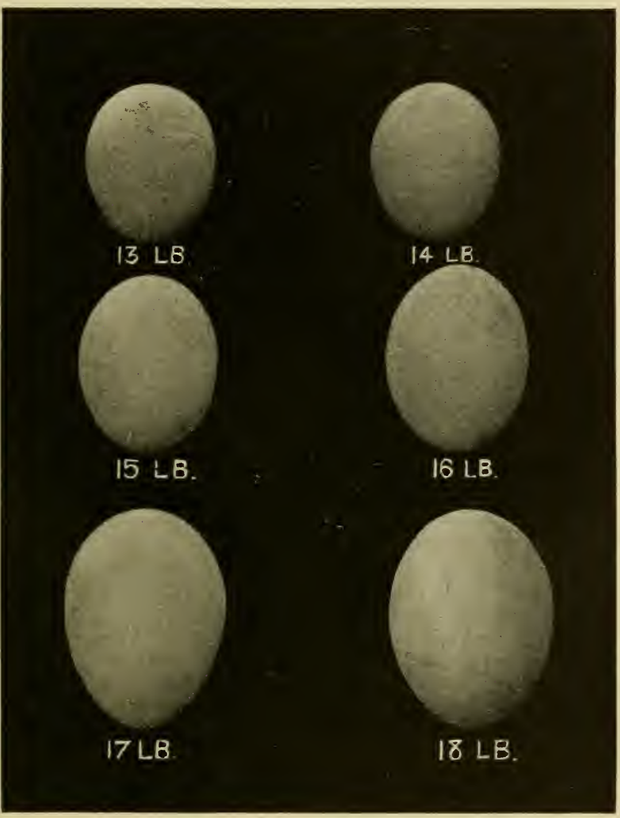


Fig. 62.—Size of Eggs.

tell the age more or less by the appearance. For that reason washing is undesirable. A dirty-shelled egg is useless for the best trade.

5. *Colour of Shell.*—Whilst it may be true that there is no appreciably greater value in a tinted than in a white-shelled egg, there is an undoubted demand value in some markets. Consumers, and therefore retailers, like a fair proportion of brown eggs, as they are called, and prefer to deal with those who can supply them. It is thought in the scarcer months that these are less likely to be preserved.

What is within an egg is of the greater importance, because in this way is determined the real value—the actual food. Unless that is in the best condition, all else goes for nothing. The buyer may be misled by outward appearance, but the ultimate judgment depends upon the egg contents. That the quality can be gauged through the shell is unquestionable. For that reason, testing by light is universal.

6. "*New-Laidness.*"—By this is meant that the contents shall be as nearly as possible what they were at the time when voided by the hen. If an egg is boiled when, say, one or two days old, it is found that the white does not inspissate to the extent that it will later, but remains milky, clothy, and flaky. The elements which make for that state disappear in three to five days, when the egg betokens its age. Something has gone which influences flavour and quality. Such eggs do not command the top prices.

7. *Fulness.*—One sign of "new-laidness" is that the egg shall be full, by which is meant that the air-space is scarcely visible. I have made observations as to the evaporation of eggs, and find that, under normal conditions, out of 120 eggs, 1 egg contents disappeared in the first 6 days, 2 egg contents disappeared in 13 days, 3 in 21 days, 4 in 29 days, 5 in 36 days, 6 in 47 days, and 7 in 60 days, so that, as a matter of weight, this is important. The test was made in cool weather. In the hot months, or if kept in a warm place, the loss would be much greater. Examination by light reveals the size of air-space, and if that is large the value is depreciated.

8. *Brightness.*—By this is meant clearness of contents through the shell, represented by dull opaqueness. There must be no spots which represent moulds, or dark areas, generally betokening development of the germ, or bacterial colonies in the white.

9. *The White and the Yolk Ligaments* (chalazæ) must be strong and firm, and also the yolk be round. A flat yolk means age. These are not revealed until the shell is broken.

10. *Colour of Yolk.*—The best eggs have a reddish-yellow yolk, not pure yellow. Again, that is unascertainable until the shell is broken.

11. Infertile eggs keep better than those which have been im-

pregnated. I am convinced that, if infertile eggs could be guaranteed for market purposes, they would soon win favour. Large producers may easily secure this result, and small ones also if they set themselves to do so.

In this connection it should be mentioned that the value of an egg is fixed, not on the farm where it is laid, not in the local packing-room, but by its condition when delivered to the consumer. An egg which might be of first quality in Norfolk, or Somerset, or Wales to-day, may be only second quality in London or Manchester to-morrow.

Value of Eggs as Food.—Weight for weight, an egg contains more nutriment than any other class of food. There is no bone or gristle, and the proportion of water is no greater than in meat. The only non-edible portions are the shell and outer membranes. A dozen eggs, costing as much as 1 pound of meat, will yield a greater amount of nutritive elements. That is one reason for rapidly-increasing demand. Flesh appears to be more feeding than eggs, due to the fibre which it contains. That, however, has no food value. Moreover, eggs can be served in scores of different ways, presenting the most palatable forms. They enter into the composition of innumerable dishes. The main factor is to recognize their perishability, and to market as rapidly as possible. Where that is the case, a profitable outlet is always available. Our chief danger at the present time is checking consumption by too rapid advance in prices.

Sale of Eggs.—Conditions have to be considered in relation to methods adopted. Over very large areas of Great Britain—that is, in residential, manufacturing, and commercial districts—local production is but a small moiety of immediate consumption. In the Metropolitan area, between 800 and 900 millions of eggs are eaten annually, of which, probably, not $\frac{1}{10}$ per cent. are produced within the immediate radius. In Lancashire, although poultry husbandry is a very important branch of farming, especially upon the small holdings which are so numerous in that county, and the more intensive methods of poultry-keeping have advanced rapidly upon allotments, consumption is five times as great as production. The same is true in many other areas. Something like three-fourths of the population of England and Wales live in urban districts.

The methods usually adopted are as under:

Direct Sale to Consumers.—That specially applies to districts where producers and consumers are contiguous, and the latter can be easily reached by the former, or the two can meet in local markets. To an increasing extent this system is impossible as density of population advances.

Sale by Producers to Retailers.—This method is that of greatest advance, and in many cases entails the least cost for distribution. Where supplies are sufficient, and of the quality required in the great centres of population and at holiday resorts, it yields an excellent return.

Local Traders.—Where the volume of produce is individually small, and must be bulked to reduce cost of transit, the producer is unable to reach distant markets, and it would not pay him to undertake that task. Therefore an intermediary must be found between him and the distributing retailer. In some cases this works satisfactorily, in many others not, especially as rings are often formed to keep down prices, and there is no alternative outlet. The great hindrance to progress is that all-round rates are paid, so that improvement of quality is checked.

Co-Operation.—In Denmark the egg trade has been largely built up on a co-operative basis, and the same system, to a lesser extent, is adopted in Ireland, Holland, and Scotland. Under certain conditions—that is, where no great local demand exists—the same system has proved successful in England and Wales. Such failures as have occurred were chiefly owing to a large existing local demand, and that prices did not allow sufficient scope for increase. As a competitive factor co-operation has proved of the greatest value, compelling traders to improve their methods. Also, by throwing responsibility for quality upon producers, it has had a great educational influence.

Auction Sales.—Regular sales by public auction have been established at a few centres, where buyers collect to purchase. These are, however, more perfectly organized in the Netherlands, usually upon a co-operative basis. Eggs are sold as from their place of origin, so that reputation is an asset; and by the use of a mechanical apparatus, fully described in my "Report on the Poultry Industry in Holland," the work is simplified. Probably this system will find adoption to a greater extent.

Testing.—All high-quality eggs are tested for quality, generally by the retailer, so far as native supplies are concerned. The place of test should be as near the point of production as possible, and by those who are in close touch with producers, paying for supplies in accordance with the quality. In that case testing ought to be undertaken by the local trader or co-operative society. The object is not merely to discern bad and stale eggs, but to divide the best from the better, the better from the good, as each have individual values.

PLATE XVIII.

Testing-Room and Table at Roermond, Holland.

For that purpose a dark room or cupboard is required. Shutters to the former and heavy curtains forming the latter will exclude light sufficiently for the purpose.

The method of testing is by passing light through the egg, so as to reveal internal conditions. A powerful lamp, gas-jet, or electric bulb, is encased in a black metal cone or box, on the side of which are one or more apertures, slightly less in size than an egg. When the last-named is revolved by hand against this opening, the size of air-space and general appearance are revealed. This individual examination is the most perfect test.

In Denmark and elsewhere strong lights are enclosed in a well, the sides of which are formed by powerful reflectors. On the top fits a tray holding 120 eggs, so divided that no light can pass except through the eggs. That is a more rapid method.

Fig. 63.—Candling Eggs.

An apparatus is used in Holland consisting of a revolving table on which are several openings, into which fit trays holding fifty eggs each. One-fourth the table is at a time in a dark cupboard for testing, there resting over well lights, as already mentioned. Attendants outside place the trays in position, and remove after testing, each lot being passed into the cupboard in turn by revolving the table (Plate XVIII.).

By one or other of the methods named eggs are assorted in accordance with their respective qualities. The single test is better than that in mass, although entailing an increase of labour.

Grading.—Continental and Irish eggs are shipped in large cases holding twelve long hundreds—that is, 1,440. The packing material is straw or wood-wool, or both. As a consequence, the eggs must be very closely graded, every one being of identically the same size; otherwise, as no divisions are used, breakages would occur to a very large extent. It is necessary that each egg shall be firmly held by the layer of packing material above and below. So carefully is this work done that eggs are carried across Europe with hardly a crack. As a rule there are six grades, 13 pounds to 18 pounds per 120.

Where other packages are used, as described below, it is enough to grade into three sizes: namely, (1) eggs 17 pounds per 120—that is, $2\frac{1}{4}$ ounces each and upwards; (2) 15 pounds per 120—2 ounces each; and (3) under 15 pounds. The proportionate sale value of the last-named is much less than indicated by reduction in weight, due to the fact that these are mainly used for cooking purposes, and not for boiling. At the same time this measure of rough grading is most important for another reason. Abnormally large and very small eggs should be consumed at home, and not sent to market. A big egg dwarfs all others in the case, making these look smaller than they are; whilst a small egg spoils the appearance of the entire lot. Evenness in size makes for satisfaction.

FIG. 64.—POCOCK EGG BOX.

Packing.—Where eggs are sent short distances, and especially if forwarded direct to retailers, they are often packed in large baskets holding about 1,200, or less. There are now several forms of egg boxes which are simple and convenient. These boxes have been greatly improved of late. One form which is largely in use is fitted with square cardboard sections, and has wood-wool between the layers. Renewals of fittings and wood-wool are very inexpensive, and it is light and easily handled. The contents can be rapidly unpacked, which is most important. The Dairy Outfit Company, of King's Cross, London, make a series of excellent boxes (Fig. 64) with felt layers, which carry the contents most securely and are very largely used. Many other forms are on the market, meeting the requirements already named.

One most important matter is that the packing shall be clean and sweet. Eggs are very susceptible to external influences, and if they are packed in dirty or fusty material they will assuredly be affected thereby. Inattention to this matter, or the sending out of dirty eggs, due to want of clean straw in the nests, will reduce their value.

Table Poultry.—In considering the sale of poultry, especially of the better qualities, it is important to remember that the trade varies considerably. Even in London, where the highest prices are realizable, the trade of poulterers differs in accordance with their position. Much higher prices are obtainable in the West End and a few suburban districts than elsewhere, and supplies must be graded in accordance with the requirements of retailers. At some provincial centres good prices can be obtained; but it is not too much to say that first, or even second, quality birds will not at present sell remuneratively in the greater part of the country. Hence it is found, on the one hand, that fatters send their best specimens to London; whilst provincial poulterers, when they require such birds, order them through the Metropolitan markets. With eggs, our object should be to get into direct touch with retailers without any intermediaries, in order to avoid unnecessary profits and to insure rapidity of transit. In respect to chickens and ducklings, it is found more profitable to send supplies to salesmen in London, as they are able to grade the fowls in accordance with the requirements of poulterers, and can thus obtain higher returns than if sent direct to the trader. The plan here suggested is found fairly satisfactory by fatters of chickens in Sussex and West Kent, and the duckers in Bucks and Beds. In provincial markets, and especially for lower grade birds, selling direct to the traders is to be recommended. Their trade, however, is not for higher-class specimens.

Markets for Chickens.—A most important point is, How are the chickens, raised in districts where fattening establishments do not exist, to be marketed? When lean birds are selling in Sussex at 2s. 9d. to 3s. 6d. each, they are often to be purchased in other districts at from 1s. 6d. to 2s. 6d. each. Ultimately we may hope to find fattening extended greatly, and the work of finishing off completed where the birds are reared. In the meantime our object should be to bring fatters into touch with breeders.

Except in the fattening districts, where the collection is very well organized, and the whole countryside is scoured by higglers buying up birds, traders frequently do not obtain a sufficient supply, nor is there regularity. A buyer may go into a local market, and one week find a considerable number of chickens, whilst the next week there may be hardly any at all. Hence the business is speculative to a considerable extent, and he must allow a good margin for profit—greater than should be the case, or would be so, if he were sure of securing a proper supply—to the detriment of the producer.

What we have, therefore, to consider is whether it is not possible to adopt another system in this country. Of course, we have markets in all directions, but these are very general, and buyers cannot tell what is likely to be brought forward. In one or two of the southern counties regular sales have been instituted, and these undoubtedly serve a good purpose; but the system has not spread sufficiently to warrant buyers from the fattening establishments attending and obtaining a commensurate supply. We must aim for something on a larger scale. Supposing in any district a market is instituted of the nature found in Belgium and France, the wisest plan would be—at first, at any rate—to fix these monthly or fortnightly, and to take steps for the producers to attend in large numbers with their fowls for sale. That is a distinctly better plan than the creation of another race of middlemen, because the competitive spirit will be more manifested, and any benefit accruing will go into the pockets of the producers rather than of the collector or higgler. If a market were held fortnightly, and the breeders all round set themselves to have their birds ready for the markets, they would then be able to take them in sufficient quantities, and the buyers would be very speedily able to regulate their trade, having a very clear idea as to the number that they were likely to obtain. In fact, they would come into touch with the producers, and obtain a very close estimate as to the supply during each season. Of course, in many cases the buyers would represent fatteners, and thus the prices would be distinctly better than are met with at the present time.

CHAPTER XXIII

POULTRY DISEASES

In no department of human knowledge has greater progress been made within the last fifty years than in medical and veterinary science, consequent upon which not only is there a more complete and scientific definition of disease, but a fuller realization of the causes, together with appreciation of bacterial and other inciting influences, and, to a lesser extent, ability to combat disease in one way or another, though in that direction we appear to be only at the beginning. On the other hand, it would seem to be true that, as a result of greater aggregation of human beings and animals, massed together in communities, and more intensive conditions of life, the tendencies to development of disease are greater than ever. Such is certainly the case with poultry, following upon a vast increase of numbers and other influences named below. That in former times there were losses by disease among domestic fowls cannot be questioned. Inquiries reveal, however, that these were comparatively few and isolated. It was not until the numbers of birds kept upon a given place were largely increased, and methods adopted which tended to diminution of natural vigour in fowls, and therefore lessened ability to repel attacks of bacterial and parasitic enemies, together with the conditions which are favourable to their rapid development and virility, that the question became of serious importance, combined with which is the economic value of poultry, now much greater and constantly advancing, not individually to the same extent as collectively. One fact must ever be regarded—namely, that power to prevent disease may be the determining factor as to further development of poultry husbandry.

Scientific Research.—During the early days of poultry husbandry, empirical methods in the treatment of poultry diseases were unavoidable, by reason of the fact that scientists had not applied themselves to study of this class of livestock. Poultrymen had to do the best they could, and to accept the consequences. As a result, it was often thought wisest and cheapest in the long-run to kill a fowl seen to be sick. With advent of the exhibition system and the increased value of individual birds, greater attention was given to the question, equally in the direction of cure and prevention. A breeder felt that he was warranted in expending money and time in saving a fowl worth, perhaps, several pounds, which was not the case when its value was measured by pence. To that fact may be attributed the increased attention given to diseases of poultry. With development of poultry husbandry on more extensive lines, where whole flocks were attacked, probably involving loss over wide areas, the importance of the question was to some extent realized. It became not merely a matter of individuals, but of flocks and of communities, compelling attention on the part of Government departments. The first decided step in this direction was when the French Ministry of Agriculture instructed the late Professor Louis Pasteur to undertake an investigation into an outbreak of what is known as chicken cholera, which was then devastating the farms of that country. That example has been followed in several instances, some of which are referred to below.

This subject has to be considered in two directions: First, diseases which are individual—that is, isolated cases, either single birds or limited groups—wherein the loss is apparently small, although probably more wide-reaching than is generally supposed, owing to inherent weakness transmitted to the progeny, thus making for degeneracy of the stock; and, second, those forms of disease that become epidemics which by dissemination cause great immediate loss, not merely on the place of origin, but by infection of considerable areas. I have seen several such epidemics or their effects in Britain, Ireland, America, Belgium, and Italy, the results of which were disastrous in the extreme, involving an enormous amount of loss.

Prevention the Main Object.—When disease occurs, except in minor complaints, a cure is frequently impossible. In no case can it be profitable. The small comparative value of each unit means that, apart from danger of infecting others, such value may speedily be expended by a course of treatment. What has to be sought for is the cause, in order that, by its removal, further developments may be prevented. Frequently such cause cannot be discovered until a vast amount of loss has taken place. In fact, not until the infection is more general are steps taken to investigate outbreaks. That is always the case, even with human beings. Probably there is no instance in which adequate preventive measures have been adopted until the necessary compulsion was applied by disease in epidemic or other forms, involving great mortality. Hence, it was not until poultry husbandry became of sufficient importance to warrant expenditure of public funds in the work of investigation, and the labour of scientists in this direction, that serious attempts were made. For example, a recent epidemic involved the direct loss of at least £50,000 within one or two provinces of Belgium in a single season, ruining many producers, and threatened with destruction an important rural industry.

The time has fully arrived, therefore, when the question must be dealt with on broader lines, to which end the co-operation of scientists whose training enables them to pathologically investigate diseases of poultry, in order that the causes may be removed, is absolutely necessary. Fortunately, in several countries the services of such men and women are now available, though not to the extent which is demanded by the importance of this question. That, however, is not enough. Whilst research into the nature of disease and its development, discovery of bacteria and parasites which are the active and immediate cause, and how these may be combated, are of very great value and importance, that deals with but part of the subject. What must be diligently sought for are the contributory conditions, whether involved in breeding, methods of treatment, environment, feeding, etc., in order that prevention may be effective, which should ever be the main object of all investigation. Practice and science must act in unison. The knowledge of advanced practitioners who have studied hygiene and sanitation, and that of investigators whose interest is in purely scientific research, are equally necessary. Without such combination we shall not attain effective methods of prevention. It is essential to clearly state the position, because some reports which have been published as to outbreaks of disease are incomplete, in that they stop at the point where these would be understood by poultry-keepers, whose interest in a disease is limited by their desire to avoid it.

Contributory Causes.—For the reason that the subject cannot any longer be treated superficially, in that it is too serious and requires exhaustive consideration, I do not propose to deal with the treatment of affected birds, but indicate, as far as our knowledge goes, what are the causes of disease in poultry, with such methods of prevention as are understood. We shall ultimately arrive at the stage when, as is already the case in some countries, public research stations will be in operation, at which investigations can be made, whether for individuals or communities, and advice given, at which the staff shall consist of men who are poultry pathologists in the true sense, in that they have specialized upon this branch of livestock. Up to the present time veterinary surgeons have devoted very little attention to poultry, because it did not pay them to do so. The owner of a horse or a cow can afford to pay an adequate fee for advice if it is sick, which fee would be three or four times the value of a hen. That has been the great difficulty hitherto. With increase of numbers, it is a question of flocks rather than of individuals.

Hereditary Influences.—It may probably be true that many diseases from which fowls suffer are not directly transmitted to their progeny. As examples, chickens hatched from eggs laid by hens suffering from tuberculosis in one or other of its forms, even where the lungs are affected, or from liver disease, do not immediately show signs that the parental disease is inherited, and sometimes may escape altogether if the conditions and methods of feeding are favourable. At the same time it is within general knowledge that such progeny are especially prone to suffer from the same disease at a later period of life. The consensus of medical opinion is that, whilst the diseases named are not directly inherited, the tendency is present in that, either by general constitutional or organic weakness, there is not the full power of resistance to attacks of bacteria. By that is meant the organ affected in the parents has a lessened degree of vigour in the descendants. On the other hand, we have evidence that bacteria or parasites may be passed by the hen into the egg, and thence to the chicken hatched from it, which is thus born to die. In the epidemic already referred to, which spread largely over parts of Belgium in 1912 and 1913, Professor Frateur, of Louvain University, discovered the same germ in eggs laid by infected hens as found in the parents. As a consequence, we have a further indication of the importance of using only sound stock for breeding purposes. By this I do not mean that, if an otherwise valuable bird has a bad cold, or even shows signs of indigestion, it should be discarded, as these are local and temporary affections which will cure themselves if left alone, and have no permanent influence. Any class of poultry that reveals indications of a serious affection should not be used for breeding. Acute diseases which are more rapid in their effects are less dangerous, for these usually end in death, or leave the birds so debilitated as to be useless. What have specially to be guarded against are the insidious affections that show few external signs, and are much slower in their development. Even with these, however, evidences are generally present that indicate debilitation. The line of safety is to avoid all risks. Personally, I believe that to seek for stock which are immune to disease is a vain quest. What we have to do is to prevent disease by favourable conditions and adoption of right methods.

Conditional Causes of Disease.—Probably the greater number of affections and diseases, chronic and active, are due to bad environment, even though some of these may apparently arise from other influences. It is impossible to limit the effects of non-hygienic or insanitary conditions, which may develop in a dozen different ways. As these have been dealt with in previous chapters, it is unnecessary to do more than re-emphasize the essential importance of the question here raised, namely, that—

Want of proper and efficient ventilation deprives the bird for several hours daily of oxygen sufficient for its needs, and, by compelling it to breathe air charged with carbonic acid gas, impoverishes the blood, overtaxes the lungs, and, if continued, so weakens the whole system as to render it unable to withstand attacks of diseases, whether chemical or parasitic.

Want of light in the house affords the conditions most favourable to increase of bacteria and parasites, which, by preying upon the fowls, gradually reduce their power of resistance. Sunlight is the most powerful germicide known.

Lack of cleanliness has the same effect as that stated above, in addition to which, however, is the action upon the body through the atmosphere, more especially as seen by ammonia from manure.

Dampness, either in the house or the soil, appears to reduce the vitality by more rapid elimination of heat, leading to chills, and often causing inflammation in certain organs.

Probably that which has been responsible for the greatest amount of disease is tainted soil. Not only does it act like slow poison upon the system, but also the manure offers a medium in which injurious parasites develop rapidly.

When all these various conditional influences are found in combination, as is frequently the case—for negligence is seldom in one direction—we have, on the one hand, reduction of power to combat antagonistic influences, and a great increase in the enemies and influences to be met. Under such circumstances everything is favourable to development of disease.

Lessened Functional Activity.—One of the penalties which frequently follows domestication is abrogation of the need for seeking food, more especially where birds are kept within enclosures and all food has to be supplied. Under these conditions, the danger of reducing the physical powers by absolute disuse is a very positive one. Young creatures may take exercise for the very pleasure of it. That, however, does not continue for long. In this respect there is a great difference in breeds, some of which are much more active than are others. Yet all are affected to a greater or lesser extent. The effect upon growing stock is seen in an undoubted, though perhaps scarcely perceptible, weakening of the system, which reacts upon frame, muscles, and organs, and the power of resistance to malign influences. As decrease of exercise, combined with an abundant supply of food, is usually followed by increase of fatty deposits in the body, the functional activity is checked; and if such birds are used for breeding, degeneracy in the progeny results, even where disease does not immediately supervene.

Causation by Food.—A famous surgeon once informed me that 95 per cent. of his patients could have prevented the need for consulting him by greater care in diet. In poultry, also, a vast amount of diseases affecting the blood and digestive organs are distinctly due to the use of unsuitable and rich food, and too much of it. I have practically come to the conclusion that soft food, except for birds intended to be killed, and for layers that are not to be used as breeders, is not so beneficial as was formerly supposed. Hard corn and green food in smaller quantities, supplemental to what can be found naturally, would go far to obviate a great amount of disease, more especially if given in the way which compels exercise. Rich food is non-economic, but has much more serious effects as a direct cause of disease.

Healthy Stock.—From what is stated above, it will be evident that, whilst conditional influences are powerful factors in prevention of disease, and where these are unfavourable cause a great amount of loss, in a large number of instances infection is transmitted from one bird to another. The introduction of a diseased specimen is frequently the immediate cause of outbreaks in one form or another. Exhibitions are responsible for a large amount of disease, as is the practice of forwarding birds in old baskets and hampers which have not been disinfected, and which by their structure provide harbourages for bacteria and parasites. An affection may be dormant, and therefore unsuspected, only revealing itself as a result of change in condition. What, however, has to be kept in view is that the introduction of a diseased bird will be harmful to the degree that the poultry with which it comes in contact are in the condition favourable to infection, otherwise the parasites he may thus introduce would be unable to exert their influence. It has been claimed that a perfectly healthy man can work in a cholera hospital without risk. Such fact explains why some birds and flocks escape, whilst others readily fall victims to epidemic and other diseases. Unless and until measures be taken to prevent disease at the source by breeding from healthy stock, kept under sanitary conditions and treated in a right way, the dangers of epidemic and other diseases must be considerable. As a measure of precaution, all newly-introduced birds should be isolated for at least two weeks before they are allowed to mix with the other stock. By doing so, time will be allowed for latent disease to declare itself. A further valuable precaution is that birds dying of disease shall be destroyed, so as to prevent spread of infection. That is often neglected.

Serum Prevention.—The late Louis Pasteur during his investigations into chicken cholera recommended inoculation by serum for prevention of that disease. The same course has been adopted in other countries, and with success, though the duration of influence appears to be comparatively short, necessitating repetition at intervals. One of the most striking examples of what has been done is in Holland. The Serum Institute at Rotterdam sends out operators as required, who inoculate fowls against chicken cholera and Klein's disease, of which there have been several serious epidemics in the Netherlands. The results have proved very successful in checking spread of the disease, mainly by rendering immune for a time the non-affected birds. As a means of dealing with outbreaks when these occur, and of limiting their scope and effect, such treatment is most valuable. As a permanent factor, I cannot regard it as possible or desirable. The labour and cost of inoculating all fowls on each farm in a district, say every year, would be great, and the benefit would be small unless this were done. That would deter the majority of farmers from keeping poultry, or they would refuse to adopt such system. As an occasional expedient, serum treatment is valuable. What must be sought for are the methods of prevention, applying these as generally as possible.

Symptoms of Disease.—Many affections from which poultry suffer can be diagnosed without difficulty, as the symptoms are apparent. Among these may be included attacks of various internal and external parasites; diseases affecting the nervous system, the skin and comb, the crop, the limbs, the oviduct, the digestive organs, and accidents. In these a mistake can hardly be made. When we consider diseases of a more complex nature, it is evident that the same symptom may be indicative of several distinct diseases. That is specially true in respect to temperature, breathing, appearance of the plumage, and the evacuations. To some extent, it is alone by careful study of symptoms in combination that a guess—and it is generally nothing more—can be made as to what is the true nature of the disease. With the more serious affections a correct diagnosis is practically impossible until the later stages, or after death, when a post-mortem is made. Under these conditions, it is of great importance that there be such examination, so as to reveal the cause and lead to measures of prevention.

Although knowledge in this direction is very incomplete, I quote below a table,* which is the best published up to the present time:

Symptom.	Diseases which the Symptom named may indicate.
Abdomen swollen	Peritonitis, dropsy, white diarrhœa.
Belching of gas	Inflammation of crop.
Breathing abnormal—*i.e.*, too rapid, too slow, wheezing, whistling, snoring, or in any way different from abnormal	Diseases of the respiratory system, arsenic poisoning, pericarditis, gapes, air-sac mite.
Choking	Arsenic poisoning.
Comb pale	Tuberculosis, dropsy, air-sac mite, infectious leukæmia, white diarrhœa.
Comb first pale, but later dark..	Enteritis.
Comb very dark	Liver disease, blackhead, congestion of lungs, pneumonia.
Comb yellow	Liver diseases, visceral gout.
Comb with white powdery scurf	White-comb.
Constipation	Simple constipation, indigestion, inflammation of oviduct.
Convulsions	Arsenic poisoning, copper, lead, or zinc poisoning, epilepsy, "harvest-bug."
Cough	Diseases of the respiratory system.
Crop enlarged and hard ..	Crop-bound.
Crop enlarged and soft	Inflammation of crop, enlarged crop, gastritis.
Diarrhœa	Diseases of the alimentary tract, arsenic poisoning, copper, lead, or zinc poisoning, blackhead, tuberculosis, cholera, roup, white diarrhœa.
Nostrils, discharge from ..	Diseases of the respiratory system.
Emaciations	Tuberculosis, aspergillosis, visceral gout, mites, white diarrhœa.
Eye, expansion of pupil.. ..	Arsenic poisoning.
Eye, sticky discharge from ..	Catarrh.
Face swollen	Roup.
Droppings bright emerald green	Cholera.
Fever marked	Peritonitis, aspergillosis, infectious leukæmia, inflammation of oviduct.

* "Poultry Diseases and their Treatment," Maine Agricultural Experiment Station, 1911.

Symptom.	Diseases which the Symptom named may indicate.
Lameness	Tuberculosis, aspergillosis, rheumatism, scaly leg, bumble foot.
Legs roughened, with scales raised	Scaly leg.
Mouth, mucous discharge from ..	Congestion of the lungs, pneumonia, gapes.
Mouth, white cheesy patches in	Roup, canker.
Nausea and vomiting	Inflammation of the crop, copper, lead, or zinc poisoning.
Neck bent backward	Strychnine poisoning, congestion of the brain, wry-neck.
Neck limp	Limber-neck.
Paralysis	Copper, lead, or zinc poisoning, strychnine poisoning, apoplexy, heat prostration.
Saliva, copious secretion of ..	Arsenic poisoning.
Skin puffed out in blisters ..	Emphysema.
Skin scaly and encrusted ..	Body mange, favus.
Staggering	Congestion of the brain, leg weakness.
Thirst excessive	Hypertrophy of the liver, peritonitis, aspergillosis, tapeworm.
Tongue hard and dry	Pip, diseases of the respiratory system.
Tumours on head	Roup, chicken-pox.
Urates yellow	Cholera.
Vent, mass of inflamed tissue projecting from	Prolapse of oviduct.
Vent, skin inflamed	Vent gleet.

Generally speaking, however, whenever a bird is sick, that fact can be discerned by its appearance, common to all affections. The work referred to on this point says: " A sick fowl is usually quiet, and does not move about unless disturbed. It stands or sits with the neck contracted, so that the head is pulled well into the body, giving the bird a 'humped-up' appearance. The eyes are often closed, entirely or partly, giving the bird a sleepy appearance. Often the feathers are roughened, and stick out all over the body. The comb and wattles may be dark, or, on the other hand, may be very pale." When seen to be sick, a bird ought at once to be isolated, and a hospital should always be provided where the numbers kept warrant such an arrangement.

Post-Mortem Examinations.—Where an outbreak of disease appears to be serious, application for advice should be made either to the veterinary deparments of the various Boards of Agriculture in London, Edinburgh, or Dublin, or to a qualified expert. It is, however, desirable that the poultryman should know how to make a post-mortem examination. The following description is taken from *Poultry :*

" Let it be understood that a very large number of poultry which die are victims of some entirely simple complaint, such as enlargement of the liver or tuberculosis in the lungs. These complaints are easily recognizable, and there is no reason at all why any farmer or amateur poultry-keeper should not be able to form a general opinion as to whether his poultry are dying off from some such complaint as one or other of these. Take the dead bird and lay it on a wooden table, or on a piece of strong board, breast uppermost. Spread out the wings and the legs, putting a small nail through the joint of each wing and through the centre of each foot. It is not necessary for the bird to be entirely plucked; it will be enough to pluck the breast, and when this has been done pinch up the skin at the point of the breast-bone, and cut it straight through, from the vent to the crop. Having done this, draw back the skin on both sides, so as to leave the flesh fully exposed, and then with a sharp knife cut through the flesh on both sides of the breast-bone, and with a strong, blunt-pointed pair of scissors cut out the centre of the breast-bone entirely, taking particular care in doing so not to injure the heart, as a flow of blood from the heart will interfere with subsequent operations. When this has been done, the principal organs will be seen clearly exposed.

"First of all examine the liver. To be perfectly healthy, it should be of a rich chocolate-brown colour, free from any specks, and free from any discoloration (although there are sometimes post-mortem discolorations at the edges, which are easily recognizable). If the liver contains any specks, it is unhealthy, as it should not be what is known as 'pasty' or 'rotten.' Healthy and firm to the touch, and of the proper colour, is the general description to apply to the liver. The heart should then be looked at, and it should also be quite firm, free from any excessive covering of fat, and also quite free from little nodules of tuberculosis. Another thing about the heart is that it should be even-lobed—that is to say, it should not be distended on one side and empty on the other; if it be so, the probability is that the bird has died from heart failure, and, supposing it is known that the bird did die suddenly, this can at once be accepted as the cause—syncope, failure of the heart's action, which always ends in very sudden death, the bird simply dropping down dead without any warning. The lungs, which will be seen on either side at the back of the heart, are spongy-looking bodies of a pink colour. If a piece of one of the lungs can be cut off and be placed in a bowl of water, it should float, not sink, or it will be unhealthy. Always look at the lungs for tuberculosis, which is usually to be detected there, and is indicated by little cheesy nodules in the substance of the lungs, which cannot possibly be mistaken; sometimes the lungs and the heart will all be eaten by these tuberculous masses. If no disease has been found so far, proceed to examine the crop and the gullet, also the windpipe. With regard to the crop, it might also be examined first, if it is full of food, and apparently in a state of congestion, to see whether there be a stoppage in the opening from the crop to the proventricle. The gullet and windpipe can also be examined, to see if there is anything unhealthy about them. Similarly, an examination can then be made of the intestines, and, in the case of a hen, the egg organs can be carefully dissected, to see whether there is a broken egg, or whether any egg substance has escaped into the cavity of the abdomen and set up inflammation.

" There is no difficulty about making an examination of the skull, and the amateur, with a little practice, will very easily be able to do this. The way to set about it is to start at one corner of the mouth, and with a pair of sharp-pointed scissors cut around the skull to the other corner of the mouth; it will then be quite an easy matter to lift up the skull from the back, and the brain will be clearly seen. This should be perfectly clear, and if there be any trace of a slight effusion of blood, it will be positive evidence of an apoplectic seizure, and will confirm the symptoms, which are delirium, resulting, after a few hours' or a few days' helplessness, in death. These, then, are the principal points, and any amateur can make a simple, matter-of-fact examination such as has been described, very often with considerable satisfaction to himself."

Parasites.—Disease is in many cases caused by parasites, which also prey upon poultry, reducing their vitality. Of these are many forms. What we must accomplish is keeping them in check. Professor F. V. Theobald, M.A., in an article appearing in the *Journal of the Board of Agriculture,* made the following suggestions:

" Infestation is always worst in dirty and neglected runs and roosts, and such are a standing danger to more cleanly neighbours. Cleanliness and freedom will always put these pests under a disadvantage—not only cleanliness of the nests, walls, and floor, but also of the ceilings and perches. To suppress these pests, the houses should be cleaned down at least twice a year with a wash made of lime, sulphur, and soft-soap, the ceilings, walls, and nests, having a good coating. The wash should be fairly liquid, so as to run into every crack and crevice. Early spring and autumn are the times for these applications. The perches are best treated with boiling water and soft-soap, or with an emulsion of kerosene or creosote. This latter insecticide is most beneficial, especially in regard to mites.

" Special attention should be paid to the nests; they should be frequently cleansed and changed to keep off fleas and other parasites. Neither nest-boxes nor perches should be fixed; relays of each should be at hand, so that they can be changed to insure complete disinfection. The nest-boxes should be now and then cleaned out, and dressed with hot lime and sulphur, or with a solution of corrosive sublimate. Either dusting the prepared nests with Persian insect powder or putting a little sawdust or sand soaked in naphthaline at the bottom will keep off these depredators. Wood-shavings or wood-wool in the nests instead of straw is most beneficial. No lice or fleas will live in it, owing to the aromatic odour given off from the wood. Care, of course, must be taken that the remedies employed do not affect the eggs in the nest.

"Schneider's suggestion of fumigating the roost with sulphuret of carbon, put in small phials in the corners of the houses, etc., where they cannot be upset, is very successful so far as killing the pests goes, but this method is not quite safe to recommend. Regarding the infestation of the birds themselves, white precipitate seldom fails. The heads and necks of young chicks should be early dressed very sparingly, and repeated when necessary. White precipitate is a strong irritant poison, and needs the greatest care in its use, especially in young chicks. It is best obtained as an ointment from the chemist's. Hens selected for sitting should have a small quantity of this ointment rubbed in under the vent, head, and sides, and then be well dusted with insect powder. Sitting hens are greatly tortured by parasites, and their young are often lost by neglect of these simple precautions. The skin should be first moistened with soft-soap and water prior to dusting the birds with insect powder (pyrethrum). Some breeders prefer flowers of sulphur. Dust baths are the natural remedy for lice and mites, and fowls should never be kept without them. Sand mixed with a small quantity of creosote will generally keep the birds free from vermin. Finely-divided gypsum mixed with a small quantity of paraffin or carbolic is still more successful for these dust baths, quickly getting rid of any lingering pests that the birds cannot reach."

Simple Affections.—Below are dealt with a few affections that are more or less local, and in which treatment may be attempted by the poultryman:

Crop-Bound.—This is the commonest form of crop trouble, and is generally caused by careless feeding. If green food be withheld for a time, and then given in unlimited quantities, the fowl will eat to repletion; and as the crop cannot deal with this mass of undigested food all at once, it becomes hard, and not only itself cannot pass into the stomach, but effectively bars the way for other food. This same result may be caused by feeding new grain, which, swelling in the crop, becomes a solid mass, or by the presence of a twig, or some undigestible substance that has been swallowed by the fowl. The proof of a bound crop is purely external, but is, fortunately, very easily discernible. Instead of the organ having a firm, close appearance—in fact, not being seen—it hangs down like a bag, and on feeling it we find that there is a lump or ball of food inside. If the trouble is discovered early, cure is comparatively easy. The first step is to pour some salad-oil or melted lard down the throat, and then to work gently the crop contents by the hand. This, if properly and effectively done, will soon cause the food and the fluid to mix, and when the mass has been well broken up, it will in the course of a few hours pass away.

When the kneading process is ineffectual, then an operation becomes necessary. The process is to make an incision lengthwise in the upper part of the crop, about 1½ inches in length. This should be cleanly made through the skins with a very sharp sterilized knife or lancet. Through the incision the contents of the crop may be removed, using for that purpose a small egg spoon. Sometimes the mass is so hard that it cannot pass through the aperture, and in that case it must be broken up, which can be accomplished with care and patience. This mass is usually very offensive, and, to remove any contaminating matter remaining, the organ should be washed out with warm milk and water, or any weak non-poisonous disinfectant. It is also desirable to pass the finger, well pared and oiled, into the orifice, so as to be certain that there is no obstruction of the œsophagus, otherwise the whole process may have to be repeated. This done, the incision must be sewn up, for which a small bent needle should be employed, as by it the skin can be easily gathered together, using white silk or horsehair. The inner skin should be sewn first, and then the outer.

Soft Crop.—In some instances, when the crop is distended, there is no mass of food, and the distensoin is a surcharge of water or air in the crop. The cause is difficult to determine, but probably arises from some inability on the part of this organ to perform its functions. When discovered, an attempt should be made to expel the contents by holding the fowl upside down, and pressing the crop with the hands. If this does not secure the desired effect, it then becomes necessary to puncture the crop. A coarse darning needle will answer very well for the purpose, and the incision, when made, will not need stitching.

A fowl found to be affected should be kept in a pen by itself, where it cannot obtain any food except that supplied to it, and be fed three times a day with a small quantity of toasted bread.

Soft Eggs.—One of the earliest forms of derangement of the egg organs is indicated by the laying of soft eggs. Sometimes, however, this is merely due to want of shell-forming materials, chiefly with fowls in confinement. When birds are kept in small runs, and commence to lay these soft eggs, the first thing is to see whether they have sufficient calcareous materials. If this is found to be the case, it will generally be discovered that over or improper feeding is the cause. The egg organs have been unduly stimulated, so that they are unable to retain the egg until coated with the shell. Laying must be checked by the withholding of food having the slightest stimulating tendency, and by the giving of an aperient. For the latter there is nothing better than a pill composed of 1 grain of calomel and $\frac{1}{2}$ grain of tartar emetic. A little iron may be given in the water as a tonic, and the food should consist of boiled rice and potatoes. We have known, however, soft-shelled eggs caused by the hen being frightened, and to prevent this the nests should always be in as quiet a place as possible. At times it is found that the presence of some irritant in the egg passages causes this trouble, and when that is so, the simplest way is to try a dose of castor-oil.

Egg-Bound.—Another form is when the hen cannot lay her egg, which blocks up the oviduct. This may be caused by a contraction of the passage, or by abnormal size of the egg. The noticeable symptoms are a frequent visiting of the nest without any result, and a depression of the tail and wings, the bird showing evident signs of distress. If the egg is very large, the first step is to soften the vent with pure salad-oil. Should that treatment fail, inject an ounce of the same oil an hour afterwards. In making the injection, care must be taken not to break the egg, as that would probably be fatal to the hen. In more obstinate cases good will result from the use of warm treacle, in which some chopped groundsel has been mixed. This should be given in doses of a tablespoonful at a time at intervals of an hour, until the necessary relief has been effected. Small doses of castor-oil may be substituted, but this is not so good. In very obstinate cases the holding of the vent over a jug of boiling water, in which 10 drops of iodine to a quart of water is added, so as to well steam the organ, usually gives relief. When the egg produced is of the regular size, it betokens contraction of the passage, which is more serious, as that indicates inflammation.

Leg Weakness.—Young birds, especially of the heavier varieties reared artificially, are often troubled with a failure of the legs which prevents their moving about freely. Usually it takes the form of the bird squatting on the ground. If not treated at once, the joints become stiff, the toes curl up, and, when the sufferer attempts to walk, it can only do so on its elbows, or first leg-joints, which soon, from the friction, become enlarged, and have the skin worn off on the under-side. This weakness may be caused in various ways. Very often it is due to a more rapid growth of the frame than the legs are able to bear, and when that is the case no one can be blamed for it, as climatic influences may have been at work that could not be foreseen. Too frequently it is the result of forcing, or of a wrong system of feeding. It is most important that in all efforts to obtain size the development of both frame and flesh should go on at the same time. In a few instances we have known leg weakness to come from keeping the young birds on wooden floors. The first step should be to cease at once the giving of all food that has the slightest tendency to increase the flesh, and to substitute that which will be used in the direction of bone formation, as well as to compel as much exercise as possible in seeking for food.

Scaly Legs.—Yellow-legged birds are very subject to a form of elephantiasis, to which the name of scaly legs is commonly given. There are two forms of it. The one is due to the presence of a small insect on the legs, which is very contagious. The other arises from a deficiency of the oily secretion, thus causing the skin to dry up and split into divisions like scales. Both are easy of cure. For the parasitic form the remedy is, after washing the legs and scrubbing them with a nail-brush, to apply sulphur ointment. For the other kind a preparation made of equal parts of vaseline and zinc ointment, applied daily, will be the best remedy.

White-Comb.—Generally due to overcrowding, to bad feeding, and the absence of green food. The comb becomes covered with scurf, which, if not checked, in process of time extends down the neck, and the feathers fall off. It is really a form of scurvy. When white-comb appears, there should be immediate attention to the food, and a wholesome and liberal diet, pure water, grit for the assistance of digestion, and an abundance of vegetables, with strict regard to cleanliness. A good aperient should be given two or three times, and some sulphur mixed with soft food. The comb should be anointed with a little vaseline. The birds when cured should have a good tonic.

Worms.—Very often, when birds are troubled with worms, it is difficult to discover what is the matter with them. The chief or perhaps the only symptom noticed is that they mope or hang about. When worms are present, the safest and best proof is by an examination of the droppings, in which worms will generally be seen if the bird is so troubled. The cure is, happily, not a very difficult one. The best remedy, so far as my experience goes, consists of capsules of turpentine, one or two of which, followed in twelve hours by a dose of castor-oil, have always been sufficient to expel the troublesome parasites from the system.

Various Suggestions—*Egg-Eating.*—The cause of egg-eating is sometimes difficult to determine, but usually it is simply a bad habit. A blown egg should be filled with a strong mixture of mustard and cayenne pepper, closing up the ends with gummed paper. Leave this in the nest, and, if the hen tries to eat it, she will obtain a dose she does not like, which may prove a deterrent. Sometimes the habit is due to want of shell-forming materials, a supply of which will stop the trouble. Placing the nests above-ground and in a quiet place will generally prevent egg-eating.

Feather-Eating.—Feather-eating is one of the most annoying practices that trouble the poultry-keeper, and is both difficult to account for and to cure. It arises, no doubt, from the want of something which the hens require, and which they are able to find for themselves in a natural state, for fowls with a wide range seldom show it. The want may be lime, or flesh food, such as worms and grubs, or the habit may be encouraged by the presence of insects in the feathers, which latter can be prevented by a dust bath. Those hens which are usually the culprits had better be removed at once, as the habit will scarcely be broken off if kept with the cock. Pluck the stumps of the feathers out of the cock, and wash the bare places well; then rub on vaseline or olive-oil, mixed with a tenth part of carbolic acid. Give the birds plenty of exercise by burying the corn and letting them work for it, and also hang a piece of meat or a cabbage by a string just where they can touch it, and so that it will swing about. Some bone-meal should also be given in the soft food.

Professor Theobald says: "There are two kinds of feather-eating—viz., 'self-feather-eating,' and the eating of other birds' feathers. The former is entirely due to the mites living upon and irritating the roots of the quills, and, so far as is known, the latter is caused by the same acarus. The form on the fowls makes its appearance about April, and is most prevalent in spring and summer. The mites can be easily found amongst the white, powdery matter at the base of the quill. The minute young are transmitted during copulation. The fowls pluck out the feathers to destroy the irritation caused by the mites at their base. *Prevention and Remedies.*—As the disease is contagious, isolation of the affected bird is the first step, especially if it be a cock. The mites readily yield to treatment with oil of cloves rubbed into the infected area. One part of creosote to thirty of lard or vaseline is still more successful."

Moulting.—The moulting of birds is an operation which usually takes place every year, and is the casting of one set of feathers and replacing them by entirely new ones. There is a constant change of, and growth in, the feathers all the year round, but only during the moulting season is there anything like regularity in the process. Moulting makes a considerable demand upon the system. Chickens hatched during the first four or five months of the year obtain their adult plumage about September or October; but this cannot be called a moult, and the first one takes place about the following September. Every year this becomes later and more protracted. Hence the plan advocated for laying fowls—namely, killing off birds before their first or second moult, when they are still good for table purposes, and before they have to be kept without any profit.

The time during which birds are moulting is a somewhat critical period, its nature depending very much upon the stamina and constitution of the breed. There is a considerable amount of difference in the way which the various breeds come through the moult. Some of the hardier varieties pass through it both rapidly and easily, whilst others find it most protracted and difficult. The usual period of moulting for a strong bird in its first or second year is six to eight weeks, in which time the old feathers are completely cast, and new ones occupy their place; but it is no uncommon thing to find weak or old birds taking three months, with the result that winter arrives before they get through it, and they do not recommence laying until the following spring, so that several months are lost, and when the produce is most valuable. All that is necessary for healthy birds is to give warm food once a day, mixing in it some seasoning powder, and lean meat with a little grain, such as buckwheat and hemp-seed, in the middle of the day. In the drinking water put a little sulphate of iron and sulphuric acid—say two pieces of the former, the size of nuts, and ten drops of the latter, to a gallon of water, and, of course, this must be renewed every day, as fresh water is most important.

CHAPTER XXIV

THE BUSINESS SIDE OF POULTRY HUSBANDRY

Formerly there were two ideas commonly held by agriculturists which profoundly influenced the way in which poultry were regarded in connection with farm operations. These were, first, that poultry as stock could not be made profitable as could other animals, but that, by the utilization of food which would otherwise be wasted, they contributed in some slight degree to promote the general prosperity of the farm. That view was held by many who were not antagonistic to poultry as such. And, second, that whilst the fowls might provide an interest for, employment to, and "pin-money" for, the female members of the household, or by forming a minor pursuit help in food-supply for the family, this branch of livestock was beneath the notice and not worth the labour of men. Both of these positions have been frankly abandoned. Abundant proof is forthcoming that, under proper business control, poultry husbandry in association with farming, whether the occupation be large or small, can be made one of the most profitable branches; and that, whilst women will always occupy a prominent place in relation to poultry culture, and that for many of the operations they are better qualified than men, the wider outlook of the latter and their greater opportunities are essential factors. It is a man's and a woman's business. Each is the complement of, and a necessity to, the other.

Capital.—Under farm conditions the ordinary questions of capital in respect to poultry husbandry do not enter. As the poultry side develops, expenditure there must be for houses and appliances, though this need not be great, more especially if the business be built up gradually. Rent, buildings, labour, and working capital, are either not required, or are small compared with what would be necessary on a poultry farm, whether that be for production of market eggs and poultry, or as a breeding establishment. Under the former conditions, what is stated above, together with purchase of fresh stock, is all that has to be provided for. Even upon a good-sized holding, unless there be any measure of specialization, £50 to £100 will cover all the capital that need be expended. Upon small holdings £10 to £25 will often be enough.

The question assumes a totally different phase when operations are primarily limited to the poultry, and such cultivation as there may be is secondary. Then capital is required for everything. It must be sufficient to provide money during the formative period, and for the time before returns can be secured. Where so many promising enterprises have failed is that, whilst the capital was perchance enough to establish and equip the plant and purchase the stock, there was no margin to provide means of living during the first two years—that is, until profits could be realized. As this question is of considerable importance, and there is a great danger of misunderstanding the facts of the case, it must be considered at length.

The Standard of Life.—First and foremost it is essential to know that the standard of life is an important factor, for upon that will largely depend the scope of operations, and whether the profit obtained is satisfactory or otherwise. A labourer whose wages are from 15s. to 20s. per week, who does not pay more than 2s. or 3s. in weekly rent for house and garden, and who can make his poultry fit in with other work, would feel that he was on the highroad to fortune if he earned £20 per annum out of his fowls. He and his family would do the work, there would be no false pride in the selling of the produce, and he would not spend money on appliances more than to a very limited amount. At the other end of the scale is the standard set up by many who require a house to live in which will give them modern comforts, probably with a good garden, maybe a stable for a pony or a motor-car; they have ideas about what work they can and cannot do, and would be unwilling to sell their own produce. Hence it will be seen that in their case expenditure is on a higher plane, that cost of production is greater, and that, therefore, the overturn must be correspondingly increased. It is not too much to say that many failures in poultry-farming have been due to the basal and living expenses being on a scale which could not possibly be supported by the amount of business done. Three hundred laying hens might (I do not say would) maintain life in a four-roomed cottage—a simple life all the time—but would be totally inadequate for an eight-apartment dwelling with its greater comforts and expenses. In poultry-farming, it must be remembered, as Ruskin says, that "the true benefit is to extinguish a want—in living with as few wants as possible."

Not a Farmer's Question.—Believing, as I do, that whilst the great bulk of eggs and poultry must ever be produced by ordinary farmers, and what may be termed special poultry farms are essential to the progress of the poultry industry, it may be pointed out that the operations which would yield a satisfactory profit to the former would spell failure to the latter. The farmer has practically no basal expenses. Rent, taxes, labour, have to be met whether he keeps a single hen on his place or not. With him it is simply a question of a few special capital outgoings, such as those for stock, houses, and appliances, and for feeding the birds. The cost of production is much less than can ever be the case on special plants, and, moreover, the fowls will help him in his ordinary cultivation by manuring the ground. They will find, too, an important part of their food at no cost to him. Under these conditions the manurial value of fowls is greater than the rental value of ground occupied by them, and therefore rent should not be charged. My contention has ever been that, properly managed, every hen kept by a farmer, whether he has five or five hundred, will return him a living profit over the food cost, varying, of course, with the class of bird kept and its productiveness.

Basal Expenditure.—Before profits are realizable by the poultry farmer, what are known as establishment charges must be met. The margin beyond, if any, is his remuneration. It is necessary, therefore, at the outset to see what these mean, because by so doing we shall be in a better position to appreciate both the scope of operations and the amount of capital calculated to secure a successful issue. At this point it is desirable to state that a common mistake is to charge rent of dwelling, and in some cases household expenses, against the poultry farm. That ought never to be, as these are personal charges.

Production Returns.—Looking at the question first from the standpoint of production for market, it is possible to see what scale of operations will be necessary. It has been proved that a hen kept for egg-laying can be made to yield a gross profit of 5s. per annum over the actual cost of food. But that will only be where the average fecundity is satisfactory—say 110 to 120 eggs per annum, where feeding is careful, and good markets are available, all of which profoundly affect the result.

If we take 4s. as a safer estimate, then 300 laying hens must be maintained to provide for the £60 establishment expenses already named. If 600 hens are kept, there should be a profit on this item of £60 per annum, to achieve which more land than 10 acres should be secured. That need not, however, influence the result, as the rent of any additional land should be more than met by the crops taken therefrom. More than 600 hens would involve additional capital for houses, etc., and for labour, so that the gain would not be on the same ratio.

In some districts it is found profitable to go in for raising table chickens, though that is so for only a few months of the year, whilst the establishment charges continue for the entire twelve months. To meet the £60 referred to above, 800 chickens must be bred and sold. With the space and labour involved in the sum named, without any attempt at fattening, 2,000 might be raised, in which case a profit to the owner of £90 per annum might be obtained. Beyond 2,000, more land, more labour, more capital, would be needed, reducing *pro rata* the additional gain. Of course, in many instances a combination of the two branches would give better results.

Production for Market not Sufficient.—What has been stated above indicates at once why so many ventures have failed—namely, because they were on too limited a scale to yield the margin of profit required by their owners beyond establishment expenses—and why farmers succeed in production for market where specialist plants do not. It also explains the great American plants, where thousands of laying hens are kept. I do not say that we shall never attain success in that direction, but the end is not yet in sight—not, at any rate, so far as the purely marketing trade is concerned, though we are nearer to it than was true a few years ago.

It is the farmer who makes money out of egg and poultry production for market, not the specialist, who must gain his rewards by increasing not so much by quantity as by enhancement of returns for the same number. Hence poultry farmers are those who make their money as breeders, not as food producers, though they should ever keep that side in view, making it subsidiary, however, to the other. Poultry husbandry needs the farmer as producer, the specialist as breeder.

Leakages.—Many there are who appear to imagine that success is to be achieved by the amount of money expended. That capital in one form or another, for it is not always represented by money, is a necessary fertilizing element is an undoubted fact.

That it can be wasted is equally true. That many expend relatively large sums needlessly is equally correct. Expensive houses, appliances, and foods, do not make for success, as they enhance the cost of production, destroying all chance of profit. Some of the most successful poultrymen have built up their businesses on a very small money capital, securing their living during the earlier stages in other ways.

It is not, however, in the direction of great expenditure that many poultrymen fail to attain the measure of success that is within their grasp, but rather by neglect of small economies which steadily tap their possible profits. Such leakages, small in themselves, make a formidable total in the aggregate, and it is these which need to be carefully watched. They can best be defined by the term "waste." That brings no return, and often entails greater loss than is represented by the immediate depletion of cash. Capital expenditure is necessary, and, when wisely made, is in itself an economy, but waste can never be economical.

Houses.—Good houses are a necessity, and it is generally cheaper in the long-run to spend more at the outset on well-made erections which will last a considerable time, than to buy or erect those flimsy poultry houses which are only too common. A low-priced house is seldom cheap, and should be avoided by the poultry-keeper. On the other hand, too elaborate buildings are a mistake.

Economics in houses are not alone covered by first cost, but also by the keeping of the buildings in good repair. Small renewals should be made as they are required, often avoiding the need for larger outlay. "A stitch in time saves nine." How often do we find that five minutes' labour, not given at the proper moment, involves a considerable loss! Houses regularly painted or tarred will last for years; neglected, rot sets in due to damp. Any loss which arises from neglect of these reasonable precautions is absolute waste, a reduction of profit, both immediate and in the future.

Keeping Birds too Long.—No fowl should be kept a day longer than is required or is profitable to the owner, and yet this is a very common mistake, especially among smaller poultry-keepers. There is a general feeling that it is a pity to sell a hen whilst she is laying, and thus, instead of disposing of her in June or July, when prices for old birds are good, the fowls are kept. When they fall into moult, they at once lose much of their value, and yet are consuming food all the time, and have ultimately to be sold at low prices, whilst in the meantime they are occupying space that would be better employed for the year-old birds and for the growing chickens.

Selling Old Hens.—"It is easy enough to sell young chickens, but what about the old hens?" is a problem often presented for solution. At first it may seem to be a difficulty, but that is not the case in reality. At certain seasons of the year there is a good demand for these hens, and at fair prices, principally for use by Jews. Wherever a Hebrew colony is found, there a trade can be done in this direction; but it must be borne in mind that the birds have to be killed by the Kosher butchers, and must not be sent forward dead, as is the case with fowls for Gentile consumption. In London there is a regular market. Various salesmen make a speciality of the trade, and they are on the lookout for suitable birds.

When the stock of poultry is properly managed, every year half the laying hens should be got rid of, their place to be taken later on by the young pullets. The best time to get rid of them is about June or the early part of July, when they will have given their spring quota of eggs, and before the market is seriously affected either by the influx of game or supplies of foreign chickens. If the business is systematized, the older birds have not fallen into the moult at the time named, and thus, having only passed through one of these annual castings of the plumage, they do not make by any means bad eating if fed up or crammed for a fortnight or three weeks. Unless they are killed then, it is more than likely that they will have to be kept three months longer, when the prices will be considerably lower, and all the food consumed meanwhile is practically used to no purpose.

Manure.—One of the directions in which a great amount of waste takes place is in the manure produced by poultry. This statement does not apply to farms where the birds are to a large extent at liberty, for in that case the soil receives the enriching influence, which is distributed in accordance with the movements of the birds. That this influence is very considerable cannot be doubted, for there are many cases where land has been very greatly improved as a direct result of the keeping of fowls upon it, and steps should be taken to prevent any waste in that manner. Where, however, the greatest amount of loss is met with is the manure produced in the houses, and unless care is taken very valuable material is either thrown away or so dealt with that its virtue is lost. Upon a farm the wisest plan is to scatter the manure as any ordinary fertilizer, but to do this it must be kept to the right season of the year.

The manure produced by poultry is greater than is commonly supposed. Observations made upon the College Poultry Farm, Theale, in 1907, afford important data.* The following were the results arrived at:

PRODUCTION OF MANURE.

Bird.	Weight of Manure per Week.		Annual Weight (Moist).		Annual Weight (Dry Matter).	
	lb.	oz.	lb.	oz.	lb.	oz.
1. Wyandotte cock	1	13	94	4	38	0
2. Faverolle hen	1	11¼	99	9	36	0
3. Growing chicken (14 weeks) ..	1	2½	—		—	
4. Fatting bird	1	13¼	—		—	
5. Aylesbury duck	6	10¾	346	14	76	5
6. Goose	10	1	523	0	91	0
7. Turkey	4	1⅓	212	0	53	8

Analysis revealed very considerable variations in the composition of manure produced by different birds under different conditions. The results as recorded in the above test are shown in the table on p. 403.

Taking the quantities of manurial constituents in the above samples, and estimating their value on the following basis—

Nitrogen	12s. per unit (*i.e.*, 1 per cent. per ton).
Phosphoric acid ..	3s. ,,
Potash	4s. ,,

we arrive at the relative values when in moist and air-dried conditions respectively:

ESTIMATED VALUES OF FRESH MANURE PER TON.

	Nitrogen.		Phosphoric Acid.		Potash.		Totals.	
	s.	d.	s.	d.	s.	d.	s.	d.
1. Fowl at liberty	21	0	3	0	2	2	26	2
2. Fowl in confinement	17	8	2	2	2	0	21	10
3. Fattening fowl	27	4	2	11	2	2	32	5
4. Duck	14	7	3	3	1	7	19	5
5. Goose	6	4	0	7	1	4	8	4
6. Turkey	12	3	2	0	1	11	16	2
7. One-month chicken	20	6	1	5	1	9	23	8
8. Three-months chicken ..	10	10	1	1	1	1	13	0

* *Journal of the Board of Agriculture*, March, 1907, pp. 719-727.

COMPOSITION OF POULTRY MANURE.

	Fresh Sample.	Air-dried Sample.
	Per Cent.	Per Cent.
1. Manure from birds at liberty:		
Moisture	59·5	9·96
Dry matter	40·5	90·04
Containing nitrogen	1·75	3·99
,, phosphoric acid (P_2O_5) ..	1·00	2·27
,, potash (K_2O)	·54	1·22
2. Manure from birds in confinement:		
Moisture	68·3	9·5
Dry matter	31·7	90·5
Containing nitrogen	1·47	4·21
,, phosphoric acid (P_2O_5) ..	·71	2·04
,, potash (K_2O)	·49	1·4
3. Manure from fattening birds:		
Moisture	70·3	15·0
Dry matter	29·7	85·0
Containing nitrogen	2·28	6·52
,, phosphoric acid (P_2O_5) ..	·97	2·77
,, potash (K_2O)	·55	1·57
4. Manure from ducks at liberty:		
Moisture	78·0	10·0
Dry matter	22·0	90·0
Containing nitrogen	1·2	4·90
,, phosphoric acid (P_2O_5) ..	1·09	4·46
,, potash (K_2O)	·39	1·6
5. Manure from geese at liberty:		
Moisture	82·6	9·1
Dry matter	17·4	90·9
Containing nitrogen	·53	2·8
,, phosphoric acid (P_2O_5) ..	·19	·97
,, potash (K_2O)	·34	1·8
6. Manure from turkeys at liberty:		
Moisture	74·7	8·0
Dry matter	25·3	92·0
Containing nitrogen	1·02	3·7
,, phosphoric acid (P_2O_5) ..	·66	2·4
,, potash (K_2O)	·47	1·7
7. Manure from chickens one month old:		
Moisture	72·8	11·0
Dry matter	27·2	89·0
Containing nitrogen	1·71	5·56
,, phosphoric acid (P_2O_5) ..	·48	1·56
,, potash (K_2O)	·43	1·4
8. Manure from chickens three months old:		
Moisture	77·7	11·1
Dry matter	22·3	88·9
Containing nitrogen	·9	3·61
,, phosphoric acid (P_2O_5) ..	·35	1·44
,, potash (K_2O)	·28	1·14

Estimated Values of Air-Dried Manure per Ton.

	Nitrogen.		Phosphoric Acid.		Potash.		Totals.	
	s.	d.	s.	d.	s.	d.	s.	d.
1. Fowl at liberty	47	11	6	10	4	11	59	8
2. Fowl in confinement	50	6	6	1	5	7	62	2
3. Fattening fowl	78	3	8	4	6	3	92	10
4. Duck	58	10	13	5	6	5	78	8
5. Goose	33	7	2	11	7	2	43	8
6. Turkey	44	5	7	2	6	10	58	5
7. One-month chicken	66	9	4	8	5	7	77	0
8. Three-months chicken ..	43	4	4	4	4	7	52	3

It will be understood that these figures are arrived at by assuming that the unit value of the constituents of poultry manure is approximately the same as the unit value of the chief artificial fertilizers.

The conclusions arrived at were that the annual value of manure of adult fowls per annum was—

	s.	d.
Fowl	1	1
Duck	3	0
Goose	2	0
Turkey	1	6

Also that the manurial value of a chicken during the growing stage to six months old is 2·8d.; and that in three weeks a fattening fowl will produce 5 pounds 8 ounces of manure, value 0·95d., or that 408 fowls in the time named will void a ton of moist manure, value £1 12s. 5d.

Treatment of Manure.—In the report referred to, it was recommended that where manure as produced falls directly on to the ground, whether arable or pasture, it may be assumed that the full value is obtained if the land is cropped in due rotation. Otherwise it is necessary to see that it is properly stored and dried. To leave it in a heap in the open is certain to lead to deterioration of its essential qualities, both from washing away of soluble materials by rain, and by fermentations which set free ammonia and other volatile nitrogenous substances. Fowl excreta forms a distinctly nitrogenous manure which stimulates vigorous growth of the leaves, stems, and roots, of plants generally, as much as a dressing of nitrate of soda or sulphate of ammonia. It contains, however, in addition to nitrogen, an appreciable amount of phosphates and potash in a rapidly available form, and on this account is a good complete manure. Its value as an all-round fertilizer for all kinds of crops can be materially enhanced by mixing it with mineral superphosphates at the rate of 1 part of the latter to 5 or 6 parts of the fresh manure.

Such as have a demand for it in a pure state should spread it thinly on trays in a shed, so that it will dry and yet retain its elements. These trays can be built in stacks. In this form fowl manure is valuable for farmers, fruit growers, and gardeners, alike. It is also used for tanning. In the fattening districts of Southern England there is a demand for air-dried manure at £2 10s. to £3 per ton, which fairly represents its value, as it has usually a moderate proportion of sand or earth mixed with it. Wherever feasible, it should be stored in a covered shed. When dried, the compost named above can be used at the rate of 6 or 8 hundredweights per acre of cultivated or fruit land. A useful plan is also to mix 2 parts of moist poultry manure with 1 part of ordinary soil by weight. In this case alternate layers should be made of earth and manure, leaving the whole until both have dried, when it is ready for use.

Food.—In no item of expenditure is there more actual waste than food. For every bird dying of starvation ten thousand die from overfeeding. As previously stated, the food supplied should be supplemental to, and not in place of, what the fowls obtain for themselves. Hence they should be encouraged to forage as much as possible. Millions of wild birds live on the poultry-keepers of the United Kingdom.

In buying food economy is necessary. We generally find that farmers desire to charge more for their small grain to poultry-keepers than better quality can be bought from corn merchants. Corn and meal should be purchased in sufficient quantities and at the right time. Moreover, considerable saving may be made, if any grain is cheap, by mixing with it some other food to bring it to the right ratio; and if ground is available, much in the way of vegetables and roots can be grown for the poultry.

Appliances.—The exercise of care in connection with appliances frequently saves a great amount of money. There can be no question that where such appliances or machines have to be kept from one season to another, and during a considerable part of the year are not used, there is great danger of neglect with regard to them. The exercise of precaution at the proper time prevents considerable loss and disappointment when they are wanted for use. In the case of incubators, as soon as the hatching is over the tanks should be emptied of water, carefully dried, the egg drawers and water trays cleaned, and cloths washed, lamps emptied of oil and wiped, and the machine packed up. By so doing it will generally be ready for use when again needed. If the water is allowed to stand in the boiler for weeks, and the precautions named above are not taken, probably it will be found out of order, maybe the tank leaking, when it is needed, which means considerable expense and loss. The same is equally true with regard to brooders.

Feathers.—The greater portion of the feathers used by the trade in this country are imported, and large quantities are received from Eastern Europe, where a greater amount of attention is paid to the requisite methods of preparation, and buyers can secure them in greater bulk. Feather merchants state that foreign goods are more dependable and of better quality, due to systematic sorting; that frequently native feathers are not clean, and no attempt is made to sterilize them, as a consequence of which they are often infested with parasites. All these points can be easily remedied if only due attention is given in the direction of care and preparation. In spite of the lessened value of home supplies resultant from the neglect mentioned above, feathers form an important item in the receipts where poultry are killed on a large scale. In the fatting districts it is generally reckoned that the feathers obtained should pay the cost of labour for killing and plucking.

When plucking takes place, the feathers should be kept free from blood and dirt, and be sorted as the work proceeds. To that end three hampers should be provided: one for the wings and tails, another for the down from breasts and thighs, and a third for the back and neck feathers. By so doing they are graded quite easily. The most valuable are those from the breasts and thighs; but if it is regarded as worth the labour, the third grade may be stripped and mixed with the down. The wings and tails are of small value, and frequently cannot be sold at all, in which case they are added to the manure-heap. Upon larger establishments the better plan is to put each grade loosely into large thin canvas bags, forwarding to the merchants as these are filled, as the sooner they are sold the better. Where the quantity is smaller, they should be placed in canvas or paper bags, and dried three or four times in a moderate oven, with the object of killing all parasites and of drying out the blood and sap. It is an excellent plan to beat and shake them occasionally, and to keep for some time in a warm place. Hanging the bags from the roof of a kitchen is a method to be recommended. Washing in lime-water is sometimes done, but the drying is very tedious. The following are prices which can generally be obtained: Wing and tail, 1d. per pound, when they are saleable at all; chicken and turkey down feathers, 3½d. to 4d. per pound; chicken and duck feathers mixed, 8d. per pound; duck, 1s. per pound; goose, 2s. 6d. per pound.

Labour.—To the great majority of poultry-keepers the question of labour is not of pressing importance, because whatever is required is done by themselves or their families. It is perfectly true that unless they make suitable arrangements and have proper appliances there may be a great waste in their own labour, but that does not appear upon the balance-sheet. One of the great benefits of good appliances is that they minimize the work of those concerned. Sometimes, however, appliances add to the labour. When we find people taking up poultry-keeping who cannot do the work themselves, and have to pay for labour, it becomes a more serious question, and we believe that many failures have arisen almost entirely from this cause. What is true in poultry-keeping is equally true in other branches. A lady or gentleman who goes in for greenhouses, or fruit culture, or dairying, cannot make the same amount of profit as one who undertakes these branches herself or himself, and the more this fact is realized the better it will be for everyone concerned. Labour is very expensive, and as a rule labourers will not, and cannot be expected to, work in the same way as those whose payment depends entirely upon the success of their efforts. Where labour is employed, then it is most important to keep it fully and profitably engaged, and for that purpose the enterprise should be large enough to fill the time in one direction or another.

Separating the Sexes.—Whilst it is true that the majority of breeders of exhibition stock separate the sexes in their chickens at an early age, farmers and cottagers are very neglectful indeed of this matter, and, as a consequence, trouble and loss naturally result. Some time ago I was told by a large poultry breeder, whose primary object is egg production, that if he could be sure which of the chickens were cockerels, he would wring their necks so soon as hatched. The reason is that as soon as the sexual characteristics become apparent the cockerels begin to fight each other and bully their sisters, checking their own growth and arousing instincts which are better dormant for a considerable time. Such methods are needless, for there are two ways in which the trouble can be avoided: First, by dividing the sexes so soon as they can be distinguished. On a farm this is not at all difficult, though it may involve two houses instead of one.

These should be some distance apart, and into one the cockerels can be placed, for they will live in unison if there are no members of the fair sex to quarrel about, and they will grow much more rapidly than would otherwise be the case. The second way of avoiding the difficulty referred to is by caponizing all cockerels not to be kept for stock purposes, when they are nine or ten weeks old.

Keeping Male Birds.—The question is often asked as to whether it is necessary to keep a male bird at other periods than the breeding season. It may be explained that the male has no part in production of eggs, as these are formed in the ovary, and the process will begin at the right time independently of any external influence. When fowls are kept simply for egg production, it is not necessary to keep any male birds. The only advantage found practically is that hens are sometimes quarrelsome when only with their own sex, but a cock-bird keeps them in order, and prevents trouble arising in this way.

Accounts.—Complete accounts of their operations should be kept by all poultry-keepers, not merely for the satisfaction of knowing whether there has been a profit or loss—though that is very desirable—but also as an inducement to economy. There are several poultry account-books sold which may be used, or a plain ruled book can be made to serve the purpose. At the beginning of the year all birds and appliances should be valued and recorded. Next, all items of receipt and expenditure should be set down regularly and methodically; then the number of eggs laid, and how they are disposed of—whether consumed, sold, used for sitting, or for the chickens; and, finally, a hatching record, showing the dates and number of eggs set, how many hatched, and the number reared. At the year end there will have to be another valuation, and the debit side will show the valuation at the beginning of the year, and expenditure; whilst the credit side will give receipts, allowance for eggs and chickens consumed, and a final valuation. The balance between one side and the other will determine the profit or the loss, whichever has resulted. Everything will depend upon whether the accounts are kept correctly, and the valuation is fairly made. In the case of stock birds, this should be what these are fairly worth at that time, not what they may ultimately realize. Also 15 per cent. depreciation should be taken annually off the cost of houses and equipment.

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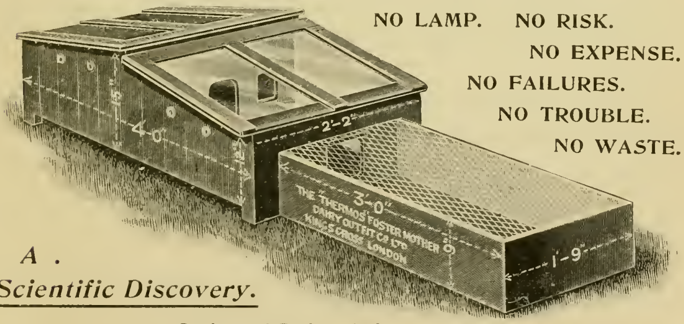

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